PARTICIPATORY EXPERIENCES IN IRRIGATION WATER MANAGEMENT

Proceedings of the Expert Consultation
on Irrigation Water Management
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1. THE MEETING

BACKGROUND

The need for adequate management of irrigation water is well recognized in most countries with irrigated agriculture. Management refers to the operation and maintenance of main irrigation system components as well as to the distribution and use at the farm level. Many administrators and technical specialists agree that the present management of both main and farm systems is often deficient and that major efforts are needed for its improvement.

The farmers, or water users, play a crucial role in the management of irrigation water. They must organize themselves to deal with water scheduling, distribution, system operation and maintenance, and related issues of distribution of work, assessment and collection of farmers' contributions. The timely and efficient interaction of the organizations of water users with local authorities, irrigation agencies and agricultural extension services is another factor of major importance. Both have been studied extensively in the Asian region and considerable experience has been gained with the participation of farmers in the improvement and management of irrigation systems. Important lessons have been learned with the mobilization and organization of water users and with the functioning of these organizations in the system's management.

The Consultation was designed to analyse and evaluate current efforts to improve irrigation water management through farmers' mobilization, participation and organization, and to examine the applicability of the lessons learned to other areas and countries. It was to address both bureaucratically controlled systems and farmer-operated systems that received substantial government inputs.

The offer of the Government of Indonesia to hold the meeting was gratefully accepted. It underlined the Government's deep interest in involving the farmers in water management. It also provided an excellent opportunity to obtain first hand information on the rich Indonesian experience, and to study the country's old indigenous irrigation management system - Bali's Subak being only one example.

The Consultation was held from 16 to 20 July 1984, in Yogyakarta and from 20-22 July in Denpasar, Bali.

MEETING OBJECTIVES

Within the overall framework of increasing agricultural production and achieving a more equitable income distribution through improved water management, the meeting was to provide an opportunity for irrigation system administrators and specialists, primarily from the Asian region, to:

i. learn, through the examination of specific cases from five countries, how farmer participation can contribute toward improved water management in agency-operated as well as in community-operated irrigation systems;

ii. identify the common elements of successful approaches to promoting greater farmer participation as well as the factors which enhance or hinder efforts to broaden farmer involvement in irrigation;

iii. specify the roles that national and local institutions need to play in improving water management;

iv. identify the forms of external (international) assistance which would be required to support national and local initiatives; and

v. formulate specific guidelines and recommendations addressed to national governments, international organizations and donor agencies for the promotion of effective management of irrigation water.

OFFICIAL ARRANGEMENTS

The meeting was organized and sponsored jointly by the Government of Indonesia, the Food and Agriculture Organization of the United Nations (FAO) and the United States Agency for International Development (USAID). The agencies responsible for the Consultation on behalf of the Government of Indonesia were the Directorate of Agriculture Area Development (Ministry of Agriculture), the Irrigation Department (Ministry of Public Works) and the Directorate of Social Affairs (Ministry of Local Government).

The technical secretariat of the meeting was comprised of representatives of the Indonesian Government, FAO and USAID, under the chairmanship

of Mr. P.J. Dieleman, Coordinator of the International Support Programme for Farm Water Management, FAO.

The local organizing committee consisted of representatives of agencies involved in the meeting under the chairmanship of Mr. Amin Hidayat, Director of the Directorate of Agriculture Area Development.

Formal sessions were held in Yogyakarta from 16 to 20 July and in Denpasar, Bali, from 20 to 22 July. Field visits were made to several irrigation schemes in Central Java, and to Subak systems on Bali.

ATTENDANCE

The Consultation was attended by a total of 67 participants and observers, representing a broad mix of senior government administrators, irrigation engineers, system operators, agronomists and social scientists. In addition to 10 participants and 17 observers from Indonesia, they included 31 parti-cipants and observers from 16 countries and donor agencies, and from international organizations including the World Bank, the Asian Development Bank, and the International Irrigation Management Institute. A complete list of participants and observers is given in Annex I.

THE PROGRAMME

The Programme of the Consultation consisted of a number of case presentations, small group discussions, field visits and plenary discussions over a six-day period. During the first two days of the Consultation, the following case studies, covering five Asian countries, were presented:

Case I. Water Users' Associations in Indonesia, by Budiman Notoatmodjo

Case II. Analysis of Technical Constraints Influencing Farmers' Participation in Water Management at the Farm Level in Indonesia, by Suprodjo Pusposutardjo, Harsono and Muchjidin Mawardi

Case III. Farmers' Involvement in Irrigation Development in the Philippines, by Benjamin U. Bagadion

Case IV. China's Responsibility System and Farmer Participation in Water Management: The Example of Yucheng County, Shandong, by Ren Hongzun and James E. Nickum

Case V. Farmers' Associations in the Pochampad Irrigation Project in India, by K.K. Singh

Case VI. Involvement of Farmers in Water Management in Gal Oya, Sri Lanka, by C.M. Wijayaratna

Case VII. Involvement of Farmers in Water Management - Alternative Approach at Minipe, Sri Lanka, by N.G.R. de Silva

Much of the substantive discussion took place in five small group discussion sessions where interdisciplinary groups of 8-10 participants and observers expressed their views on key issues and themes that emerged from the case studies. Prior to the group discussion sessions, the conference organizers provided each group with a set of guide questions for discussion. Following each session, the groups made brief reports in a plenary session in which further discussion took place.

On the third day of the meeting, the discussions focussed on what government agencies could do to promote farmers' involvement in water management and to increase their capacity to deal adequately with participatory approaches. The participants also exchanged views on actions to be taken by external donor agencies and international organizations in support of government programmes.

The formal consultation sessions were complemented by field trips to four irrigation systems in Central Java and to three Subak irrigation systems on Bali. All provided ample opportunity to discuss problems of farmers' participation and results of participatory programmes with local officials and with the farmers themselves. Of particular interest in Central Java was the Blimberg Water Users' Association (Dharmatirta) through which 400 farmers combined efforts to develop their farm irrigation system successfully. On Bali, the participants obtained first-hand information on the nature and functioning of the Subak system, a unique traditional farmers' organization that is based on strong social and religious convictions. Through cooperation and discipline Subak members appear capable of achieving a high level of sophistication in the development and operation of their irrigation system.

Following an introductory address, the Consultation was opened in the LPP Auditorium in Yogyakarta by HE Mr. Wardoyo, Junior Minister of Food Crop Production. The Minister referred to

the influence that the Subak and other indigenous systems have had on present participatory programmes in Indonesia. He considered the organizational aspects of water management to be critical to the successful operation of the irrigation system, and said that the governemnt was strongly promoting farmers' participation to improve system performance.

The Minister's opening address was preceded by introductory and welcome addresse by Mr. T.B. Suhaidi Wiratmadja, Director-General of Food Crops, and the Vice Governor of Yogyakarta, Sri Paduka Paku Alam VIII, who conveyed their hope that the meeting's discussion of farmers' participation would contribute to the improvement of the farmers' conditions in Indonesia as well as in other countries. Dr. D. Bap Reddy, FAO Representative in Indonesia, referred to the important roles assumed by FAO and USAID in promoting better irrigation management, and to the agencies' commitment to providing further support in the years ahead. Dr. Reddy, speaking on behalf of both external sponsors, conveyed his sincere appreciation to the Government of Indonesia for hosting the Consultation.

The global problem of farmers' involvement in improving irrigation water management was put into perspective by Dr. Norman Uphoff, who, on behalf of USAID, reviewed experiences from various countries, stressing in particular the neglected role of farmers as the targets as well as the means of irrigation development.

The full programme is given in Annex II.

ACKNOWLEDGEMENT

The organizers and sponsors of the Consultation wish to express their sincere appreciation to the Government of Indonesia for their hospitality and the excellent arrangements made by the various agencies and units of the Ministry of Agriculture (Directorate General of Food Crops), the Ministry of Public Works (Directorate General of Water Resources Development) and the Ministry of Interior. They would also like to extend their warm thanks to all national and international participants and observers who presented the case studies, facilitated the small working groups, communicated information and contributed in many ways to a fruitful exchange of views and, so, to the success of the Consultation.

THE REPORT

Following the Introduction, this report contains a brief summary of the Case Studies that were the base of the key issues and themes discussed in subsequent sessions.

The results of these discussions are reviewed in an interpretive summary, prepared by Dr. Robert Y. Siy of the Asian Institute of Management in Manila. It consists of two major sections. First, the key issues and themes that were dealt with at the meeting and, second, the specific recommendations directed to governments, donor agencies, and international assistance institutions.

2. SUMMARY OF CASE STUDIES

For full documentation of the case studies and country papers prepared for the Consultation, reference should be made to the separate Part II of this report.

WATER USERS' ASSOCIATIONS IN INDONESIA

presented by: Dr. Budiman Notoatmodjo, Ministry of Agriculture, Jakarta

The case studies, conducted in different parts of Java, provided the data base for an analysis of the Government's efforts to involve farmers in the management of the irrigation system.

Since the first five-year plan started in 1969, the Government has given high priority to the improvement of the physical conditions of the irrigation system. Rehabilitation of existing, and enlargement of new, irrigation systems have been carefully carried out. The programmes include the water supply, the water distribution, the water management and the software of irrigation management (personnel, training, administration, etc.).

Though the importance of farmers' participation was well recognized, the need for a speedy implementation of the programme often precluded the farmers' actual involvement in the planning, design and construction of the system.

To analyse the role of water users' associations (WUA) four models of farm-level water management in Indonesia were studied, which represent four levels of farmers' involvement. They include:

(1) The Subak Irrigation System, where the whole irrigation scheme, from water source and main system to farm level, is managed by farmers. The system is typical for Bali. The case study was carried out for the Subak of Medewi, which has 280 ha of irrigated land.

(2) The Village Irrigation System, representing the traditional farmer managed irrigation system. The case study involves the Glonggong Irrigation Scheme (irrigable area 287 ha) which has a Dharmatirta, water users' association, typical for Central Java.

(3) The Tertiary Water Master System, referring to the system where the "tertiary" water master (ulu-ulu vak) arranges water distribution and maintenance of a tertiary unit. The case study, taken from Central Java, includes an evaluation of the tasks and activities of the tertiary water master and the water users' association of Dharma-tirta. Typically, technical considerations of size and location of the tertiary unit determine the boundaries of the Dharmatirta rather than the village, as a social unit.

(4) The Village Water Master System referring to the system where the village water master (ulu-ulu), as a representative of the village hierarchy, manages the irrigation water within the village boundaries. Two cases have been studied: the Mitra Cai water users' association in Cirebon (74.9 ha) in West Java and the Hippa water users' association in the Pekalen Sampean Irrigation Scheme (156 ha) in East Java. The village water master may refer to only one village official such as in Hippa, or to a group of special village officials (in the case of Mitra Cai) responsible for managing the irrigation system.

Farmers' involvement may be effected in several ways: (i) leave the programme to the farmers, without supervision from government; (ii) as (i), but with supervision, guidance and facilities provided by government; (iii) limited government involvement, leaving the responsibility for the tertiary development to the farmers (planning, design construction, O&M); (iv) all works, including the tertiary development done by government.

Originally, during the First Repelita (1969-74), the government followed alternative (iii); later, in Repelita II (1974-79), alternative iv was applied to achieve the high targets set for tertiary development.

Increased farmers' participation and government inputs have resulted in improved water management and agricultural practices in the five cases. In particular:

- the cropping pattern and cropping intensity in the Subak system of Medewi, the Dharma-Tirta of Glonggong and the village water master system have increased significantly (from almost 200% to 260%);

- paddy yields increased from an average of 3.78 tonnes/ha to 8.9 tonnes/ha;

- farmers' income rose from Rp. 450 000/year/ha to Rp. 580 000/year/ha;

- funds of the water users' associations increased by 44 percent;

- collected penalties or fines decreased;

- a more equitable and timely water distribution was achieved among the tail, middle and the head areas of the irrigation system.

The most important lessons learned from the case studies were the following:

a. In establishing the water users' associations, the principle of bottom-up planning is important in order to gain the farmers' confidence and interest, and to integrate the existing local organization into the new WUA. The government should not enforce the building of a WUA at each village tertiary unit. During the tertiary rehabilitation process the WUA will grow and develop by itself. The problem is how to meet both the specific requirements of the government and those of the farmers.

b. The government, while retaining the farmers' responsibility for irrigation management, should provide guidance and assistance. For the Subak system and village (traditional) irrigation systems, if the government has assisted in the rehabilitation of the weir and other larger structures, the operation and maintenance of the system should not be taken over by the government.

c. The established practice of "gotong royong" or farmers' participation in maintenance and repair work should be strengthened, not abolished. To obtain increased farmers' participation, a government subsidy or incentive may be helpful. Farmers' participation should be secured from the beginning in planning, design, construction and O&M.

d. An integrated approach, combining the agricultural inputs, improved water management and better farmers' participation will yield best results in terms of agricultural production and in increased farmers' income.

ANALYSIS OF TECHNICAL CONSTRAINTS INFLUENCING FARMERS' PARTICIPATION IN WATER MANAGEMENT AT THE FARM LEVEL IN INDONESIA

Presented by: Dr. Suprodjo Puspostardjo Harsono, Department of Agricultural Engineering, Gajah Mada University.

The large irrigation development programmes implemented since 1976 encountered many technical as well as social and economic problems. To overcome these, the improvement of the water management system at the tertiary level was introduced into the programme in 1983. Farmers were encouraged to participate more actively in all phases of irrigation development.

This case refers to a study of three irrigation schemes - those of Pekalen Sampean, Situpatok and Losari - that experience problems with farmers' participation in the system's management. The study identified the following constraining factors:

- Limited water resources.

- Limited reach of the Government to carry out exploitation and maintenance of the system in order to make the main system work properly.

- Lack of sustained attempts to involve the farmers in the programme during the development of the irrigation system. Without this, the farmers who are responsible for the operation and maintenance of the system, know little about their tasks, responsibilities and the consequences of their actions.

- Limited adaptability of design and construction to local circumstances.

- Increased dependency of the farmers, due to their limited involvement in the development of the irrigation systems and their

lack of knowledge and skill in their operations.

Solutions proposed to overcome the problems include (i) the establishment of better cooperation in efficient water utilization among farmers, (ii) improvement of the mechanism of planning, design and construction of the system and (iii) involving the farmers in each stage of these activities.

FARMERS' INVOLVEMENT IN IRRIGATION DEVELOPMENT IN THE PHILIPPINES

presented by: Mr. Benjamin U. Bagadion, National Irrigation Administration (NIA), Manila

To develop processes for promoting farmers' participation NIA established four pilot projects from 1976 to 1980 in its communal irrigation programme. Specially trained community organizers (COs) were fielded to develop grass roots capability among the farmers to participate in (i) decision-making; (ii) planning improvements and expansion of the irrigation systems; (iii) securing water rights and right of way; (iv) construction of irrigation facilities; and (v) control of construction costs. The COs lived in the community of the farmers, joined community and farming activities, conducted house to house visits, and integrated with the community. After gaining acceptance they discussed with the farmers the community irrigation problems and solutions. The COs role was a catalyser, analysing, persuading, arguing and challenging but never taking away the decision-making from the farmers nor performing the tasks which the farmers themselves should undertake.

To find solutions to their irrigation problems the farmers in the pilot projects decided to organize themselves to develop their irrigation systems with technical and financial assistance from NIA.

They took an active part in the planning of the irrigation system.

Farmers discussed and assisted the NIA engineer in the preparation of maps and conducted several meetings to discuss the project among themselves and to decide how to operate and maintain the system and how to repay its costs.

Once their association was registered, they entered into an agreement with NIA for the construction of the system. During construction the associations mobilized labour and supervised the construction.

After completion, the association accepted the system for operation and maintenance and repayment of costs.

The work on the pilot projects was subsequently expanded so that the participatory approach was adopted in all the communal irrigation projects of the NIA. In this expansion, NIA had to develop capability nationwide to respond positively to organized action by farmers. Towards this end the agency undertook the following:

- conducted a rigid screening process in the recruitment of COs;
- training of COs and their supervisors;
- identification and adoption of procedures for promoting farmers' participation and amending those that discourage participation;
- training of engineers and other technical staff to gain an understanding of the organizing process and the work of the COs, and to reorient attitudes and procedures to promote farmers' participation, especially the processes of coordination of technical and institutional activities;
- an information and education campaign on the participatory approach for all personnel in areas covered by the programme.

After the projects were transferred to the associations, NIA continued its activities by assisting the associations through training in irrigation system management.

In late 1980 the participatory approach, developed in the communal systems, was applied to national systems under rehabilitation. Basically the procedures used were the same except that in the national systems the irrigation associations would operate and maintain zones ranging from 250 to 400 hectares (depending on the canal layouts) while NIA would operate and maintain the major canals. At present the national systems programme covers more than 23 000 hectares in 26 systems.

The participatory approach processes that NIA employed have yielded a

number of favourable results. In the communal systems the following have been observed:

- ready acceptance by farmers of the completed physical facilities and their financial obligations;
- increased counterpart contributions;
- improved maintenance of canals and higher irrigation fee contributions.

In the national systems the results include:

- no removal of farm ditches by farmers after construction, unlike before;
- farmers have asked and negotiated with NIA to transfer to their association the operation and maintenance of their zones under mutually agreed arrangements;
- in areas where the irrigation associations have taken over operation and maintenance, the canals are cleaner, irrigation fee collections have increased and NIA expenses for O&M have decreased;
- improved relations between NIA and the farmers.

There are many factors that contributed to the increased farmers' involvement in irrigation projects of the NIA. Among these are: (i) the participatory processes employed; (ii) support of the programme at the highest level; (iii) assistance from external agencies; and (iv) the gradual development of the programme through a learning process. What has been done in NIA may or may not be successful if applied in other countries, depending on the circumstances. There are, however, some lessons that may be learned from the Philippine experience.

CHINA'S RESPONSIBILITY SYSTEM AND FARMER PARTICIPATION IN WATER MANAGEMENT; THE EXAMPLE OF YUCHENG COUNTY, SHANDONG*

presented by: Mr. Ren Hongzun, Institute of Geography, Beijing

Yucheng County, situated in the North China Plain, derives most of its water directly or indirectly from the Huang He (Yellow River). Abundant groundwater resources are available although only 20 percent of these resources are actually withdrawn by over 3000 tubewells in Yucheng County.

In view of operation costs and the often incorrect digging and maintenance of the tubewells, most farmers prefer to use surface water.

In addition to irrigation, drainage also poses its specific problems, requiring a balanced approach to water management. The state water management organizations in Yucheng include a prefectural water diversion office, a county diversion office and the county's water control bureau. These administrative units direct the management organizations such as the commune, the production brigade and production team.

The farmers of Yucheng have participated in water control construction for over three decades. Although facilities at the main and branch levels have been built with state funds, design and critical materials, the labour has been borne by the farmers. Projects at the branch level and below were planned and designed by the state, while the construction crews were organized by the communes, brigades and teams. Tubewells were mostly built by the production brigades.

In the past, farmer participation in water construction had the following characteristics:

- the state played a strong role in organizing the farmers;
- the farmers developed and managed projects locally;
- the state's provision of necessary technical, material and financial assistance tended to deprive the farmers of initiative and independence;
- the level of management was low.

Since 1978, China's rural areas have witnessed a major institutional reform, culminating in the institution of production responsibility systems. Under the previous pattern, farmers had little incentive to work hard or manage collective resources economically. In addition, higher bureaucratic levels interfered excessively

* Summary by Ren Hongzun and James Nickum

in determining the type of economic activities which could be carried out. Beginning in 1978, farmers were allowed more freedom to adjust the relationship between grain and other field crops, which resulted in a doubling of farm incomes.

The latest stage of reform, the production responsibility system per se, was introduced in 1981. Under this system, land and small agricultural implements have been divided among farm households for their use in cultivation, allowing a relatively high degree of independence in the use of labour and in operations. This has led to another substantial jump in incomes.

Responsibility systems are also being set up in water management but the progress is somewhat slower than for production operations. Yucheng County has only just begun to establish responsibility systems in water management. The county's water management departments urgently need to improve their productivity. One way they are planning to do this is to institute a system of fixed job assignments. Mass management organizations, such as the township water companies now being set up, are also aiming at establishing a system which fixes job assignments and specifications, quality standards and incentive systems.

The management of small pump facilities, primarily tubewells, has its own characteristics. Three forms of management have emerged in China: (i) where management remains collective; (ii) where several households contract jointly; and (iii) where single households or individuals contract. Nearly all of the tubewells in Yucheng are under the third system, while surface pump operations take all three forms.

The production responsibility system does appear to have brought about some improvement in water economy. Nonetheless, some problems remain:

- now that they are in possession of their own pumps, the farmers often scramble for the water and disputes sometimes break out between them. There is a clearly felt need for greater coordination;
- the location of tubewells is not always the most rational;
- there is a continuing need for technical assistance;
- there has been a disturbing tendency of late for the farmers to neglect drainage works;
- districts which divert surface water still suffer from a serious problem of wasting water;
- although there is a plethora of state management organs, most of them are busy with narrowly specialized tasks of expanding construction, maintenance and repair. None have specific authority over water use and management.

FARMERS' ASSOCIATIONS IN THE POCHAMPAD IRRIGATION PROJECT IN INDIA

presented by: Dr. K.K. Singh, Gandhian Institute of Studies, Varanasi

The tradition of people's participation was well established in India's old irrigation projects. But the large state irrigation projects built in the last hundred years have given the beneficiaries only a minor role in irrigation matters. The link between the Government and farmers is provided by subordinate Government personnel who regulate the flow of water to the canal outlet command (Chak), assess water charges or oversee systems of water distribution. Water distribution is not always fair: some hardly receive water while others over irrigate fields. System deficiencies are more widespread than acknowledged. The present situation calls for a radical change in approach to irrigation management. Monitoring of field deliveries with full people's participation as an input in main systems management could bring about a much needed change in the relationship between the developers of irrigation resources and the users.

The Pochampad project in Andhra Pradesh provides one example where an administrative strategy for irrigation development and management was developed by the Government under the aegis of the Command Area Development (CAD) Authority, paying due regard to system performance at the field level, with farmers' participation. Irrigation associations were gradually involved in irrigation management.

In the course of five years, some 3000 pipe committees were formed in the Pochampad area, a large number of which seem to function reasonably well. This confirmed the fact that farmers are both willing and capable of participating in irrigation manage-

ment and that irrigation associations can be sustained on large irrigation projects. It is noteworthy that the entire initiative came from the Government. The administrative strategy changed with experience and became progressively more effective.

Factors contributing to the success in Pochampad were:

- First and foremost, the belief of the senior project officials that the beneficiaries of irrigation, the farmers, must be fully consulted and involved in irrigation matters. Meetings at the project headquarters, field level meetings and the zonal gatherings emphasized this important point. From this belief followed a people-oriented approach as against an administrative approach to Chak development.

- Another contributing factor is the confidence among farmers that they will get their share of water and will be treated justly by the project authorities. This assurance motivated them to plan agriculture and to grow crops that offered better returns on investment (turmeric, groundnut and sugarcane). It also provided the incentive to cooperate with the Government and the irrigation association: the former with respect to loans and recommended agricultural practices and the latter as regards self-discipline in taking water, deciding on norms and adhering to them, contributing to maintenance and cooperating with committee leaders for settling disputes.

What factors contribute to viability, that is, make the pipe committees self-sustaining? Four seem particlarly important:

(1) First, the contribution of the project authorities, particularly the irrigation department. The main function of pipe committees is to deal with water. The irrigation engineer who develops the irrigation resource and manages a large system to deliver specified quantities at remote outlets has the most important contribution to make. The success with which farmers manage irrigation depends on the dependability with which water is delivered.

(2) Second is the development of management capabilities. The Pochampad experience shows that the irrigation associations can make a useful contribution and that farmers are motivated. But suitable norms, linkages and management capabilities have to be developed. For this the irrigation association requires guidance and stability.

(3) The third contributor to viability is the social legitimacy of the pipe committee. Being artificial (engineered) entities in the sense that they do not fit or follow any of the existing social institutions of a community, they have to sink their own roots. Farmers' associations can acquire legitimacy as social organizations when their utility has been demonstrated to justify a place in the existing institutional framework of the community.

(4) The fourth contributor suggested by the Pochampad experience, but not tried out there, is the need for a high level committee of members representing farmers on a minor distributary. Such a committee can work jointly with the administration to tackle unauthorized use of water in the upper reaches, refer field level problems to the appropriate level of government and return to farmers with acceptable solutions.

The Pochampad experience holds out a promise. Irrigation associations can be set up in large irrigation projects and they can carry out the functions expected of them. It also bears testimony to the enormous capability of government officers to formulate and implement ideas on the sheer strength of personal conviction and the ability to learn in the process of programme implementation. But there is still a considerable gap in what is known and requires to be known before an acceptable strategy for large-scale implementation can be recommended. As in the case of irrigation, the potential is there. Its utilization is the problem.

INVOLVEMENT OF FARMERS IN WATER MANAGEMENT IN GAL OYA, SRI LANKA

presented by: Dr. C.M. Wijayaratna, Agrarian Research and Training Institute, Colombo

Because of serious deterioration of the physical system, the Left Bank Area of the Gal Oya Scheme, with a command area of 10 000 ha, was chosen

for a major rehabilitation project supported by the USAID and the Government of Sri Lanka. The project commenced in 1979 with the Irrigation Department (ID) as implementing agent.

Reconnaissance surveys had provided ample evidence of lack of user participation in operation and maintenance (O&M); most farmers displayed a lack of confidence in government officers. Communication between (a) different categories of officers (including engineers) within the ID and (b) between ID staff and farmers was very low. The farmers' lack of confidence and lack of desire to organize were judged to be mainly due to unreliability of water supply and lack of initiation by ID or any other agency.

To involve farmers in the operation and maintenance of the scheme a strategy was defined that would as much as possible stimulate a process of internal genesis of organizations. This planned intervention was made through a catalyst agent (or facilitator) called Institutional Organizer (IO). A group of young graduates in social sciences was recruited for this purpose.

Using methods and rules of their own choosing, they attempted to promote farmers' association and cooperation and helped to develop a conscious perception of problems and needs. How and in what ways these needs could be met through cooperation and organized efforts was discussed by the farmers themselves. IO intervention was strong enough to generate the internal dynamism of the community towards local organizations, and controlled enough not to dominate and divert such efforts by the community.

The IO promoted interaction between farmers based on a common field channel (usually 10-20) and encouraged the development of a group consciousness among them. The process was initiated through discussions with individual farmers, then with informal farmer groups and government agencies (mainly ID). The IO did not take a model organization to Gal Oya, but initiated a process, encompassing a range of options applicable to different locations and situations. Formal organizations were established at the field channel level, with the broad objective of improved operation and maintenance, reduced conflicts, and better interaction with ID. By consensus the group selected one of their members as the Farmer Representative (FR). The FR does not play an authoritative role and is not a permanent position.

A process monitoring programme, using participant observation as its main tool, was also introduced. A few "Process Documentors", selected from IOs observed and reported (to researchers) the social dynamics generated as a result of intervention. Initially the farmer:IO ratio was about 60-100 and at present, due to increased farmer cooperation and IO experience, in some areas an IO works with about 100-200 farmers.

At present almost all the field channel level farmer groups adopt rotational distributions, water-saving techniques and participate in "group-organized" maintenance activities.

Minor repairs and maintenance work, such as channel clearing etc., are done by means of shramadana, a traditional method of mobilizing labour for community work. In some cases, ID assist farmers by providing raw material and technical expertise.

Using the farmers' knowledge of design and construction of channels etc. is considered to be a useful outcome of this programme. The farmers and engineers met to discuss redesigning of field channels, and a direct and effective dialogue gradually emerged between farmers and ID staff.

Monthly meetings are held between the farmers' representatives and local level officials of all the relevant government departments (including ID) at divisional level.

A significant reduction in the disputes over water (among farmers) has been observed, as has also a systematic way of handling disputes.

The formation of distributary channel level organizations has already been started with effectively coordinated irrigation rotations among field channels in a common distributary. Farmer representatives participate in an informal manner in the District Agricultural Committee meetings, the highest level decision making body within the project.

The cooperation of farmers, the competence of the change agents and the active support of a few members of ID staff were mainly responsible for the success observed in this programme. However, the continuation of active farmer involvement in water management in the Gal Oya project as well as its extension elsewhere may be restricted if longer term commitments to more fundamental changes in the organizational structures are not made.

INVOLVEMENT OF FARMERS IN WATER MANAGEMENT - ALTERNATIVE APPROACH AT MINIPE, SRI LANKA

presented by: Mr. N.G.R. de Silva, Mahaweli Engineering & Construction Agency, Colombo

Although there are some basic differences between conditions at Minipe and Gal Oya (see previous case study), there is the common factor of the use of a catalyst in triggering off the transformation process towards better and more scientific water management.

The Minipe Irrigation Scheme comprises an area of 6000 ha of paddy land which, in subsequent stages since 1939, was finally completed in 1969.

Due to the absence of effective distribution systems and a lack of discipline among the farmers, much damage has been caused to the channel system over the years. Whilst part of the damage has resulted from poor maintenance operations, far more has been caused wantonly by the farmers themselves. The Irrigation Department has been responsible for the distribution of water and maintenance of canals to the point of delivery into the field canals. Within the field canals, it is the responsibility of the farmers to distribute the water amongst themselves and to maintain the canal system. In practice, this is rarely and generally very poorly done.

Before the Water Management Project began in 1978, the level of water management in the irrigation scheme was extremely low. Due to the deterioration of the canal systems and also because of ineffective water control, there was a serious shortage of water beyond the first reaches of every distributary canal. In addition to the serious under-productivity of the paddy lands in the project, the plight of a large number of innocent farmers who were unable to sustain themselves, made it imperative that some steps be taken to effect a better distribution of water.

To meet the need for a cadre of effective change agents to be fielded in the Pilot Area, the Irrigation Department enlisted the support of a non-governmental organization, the National Heritage Programme (NHP). This organization had as its primary objective the mobilization of local, human resources to improve agricultural production based on socio-cultural practices of the past. It mobilized the support of priests, who had great influence upon the rural masses, and other categories of people like school teachers etc. It also had a team of trained and highly motivated youths who would live with the villagers and act as catalysts in any change programme in which the NHP participated. These NHP youths proved very effective in the role of change agents in the water management effort in the Pilot Area.

As a first step, informal group representatives were elected from among the farmers to represent areas of between 2 and 4 ha in the Pilot Area. With the help of the NHP, these leaders were educated and motivated to participate in the management of irrigation water within their respective areas and in the System itself. An arrangement of coordinating committees, comprising both farmer representatives and field level governmental officers, was developed and successfully operated during the period of the Pilot Project which lasted for about a year.

The other associated activities of the Pilot Project included the organization of shramadana (self-help) activities, the promotion of socio-cultural festivals conducive to better water management, seminars and group discussions.

In the middle of 1980, following the election of formal farmer representatives under the new Agrarian Services Act of the Government, a 'committee system' of management was introduced to cover the whole project area of 6 000 ha. The Project Committee covers the entire project area whilst there are 6 Sub-Project Committees, each covering an area of about 1000 ha. These committees, with the majority representation from the farmers, also contain field level officers from the government departments providing irrigation and agricultural extension to the farmer. The farmers' representatives, each serving an area of around 100 ha, are elected by secret ballot at polls conducted by the Department of Agrarian Services.

3. INTERPRETIVE SUMMARY OF DISCUSSIONS, AND RECOMMENDATIONS

KEY DISCUSSION ISSUES: LESSONS LEARNED

THE MEANING OF PARTCIPATION

The participants were in agreement that the development, improvement and operation of irrigation systems are generally most effective when farmers have the opportunity to participate actively from the initial stages of assistance or intervention from the irrigation agency. This guideline applies not only to system construction or rehabilitation projects, but also to planned efforts to improve system management. However, they also recognized that there are different levels of participation, and that the mode of participation should be appropriate to particular local conditions and situations. In some programmes, farmer participation may be limited to the contribution of local inputs and resources in planning, construction, operation and maintenance. In other programmes, farmer participation may take the form of an active partnership of water users with agency personnel.

The mode or form of participation is usually determined by the objectives of the irrigation agency. The agency may be interested in reducing its share of irrigation development and system management costs by mobilizing resources from water users. Such resources may include voluntary labour, financial contributions in the form of water charges or amortization payments, and local materials and implements.

An irrigation agency may also recognize the value of supplementing standard engineering data with farmers' indigenous technical knowledge. The complexity of even small irrigation systems is usually greatly underestimated. Moreover, the experience of many countries has demonstrated that the information generated in topographical and agronomic surveys can be further enhanced by tapping the experience of local cultivators. The irrigation authority may, therefore, seek out farmer involvement in order to improve the planning and design of irrigation systems.

The motivation for promoting farmer participation may stem from the realization that government, given its limited resources, cannot provide for the needs of rural people indefinitely. The public sector will not be able to sustain the rates of expansion in coverage and scope which have been achieved in past years. Given current economic conditions, irrigation agencies in many developing countries are finding greater difficulty in continuously increasing the irrigated area and in accepting the associated responsibilities for system management. The emerging view is that the farmers themselves should be regarded as the prime actors in irrigation development.

Although individual opinions differed at times, the participants succeeded in qualifying what farmer participation should mean. First of all, participation implies a significant role for water users in decision-making. It is a role which goes beyond mere consultation. It also implies the ability of farmers to say "no". Secondly, in order for farmers to play an active part in decision-making, they need to evolve appropriate forms of local organization. The irrigation agency can clearly facilitate the efforts of farmers to organize themselves. However, in order to facilitate this process, the irrigation agency needs to develop a planned intervention strategy. Thirdly, the timing of farmer involvement is crucial. Farmer participation is most effective when it takes place from the initial stages of project development, including the stages of plan formulation and design. These points form part of the ideal conditions for genuine participation, for a true "partnership" between farmers and government.

There are, however, field situations where active farmer involvement may not be feasible or practical. For example, where there are frequent conflicts between different groups of farmers, it may not be possible to develop viable water users organizations. Likewise, the planning of large-scale projects usually requires a level of technical expertise which farmers would not have. There are also situations where farmers would have no incentive to participate in decision-making. Consequently, the level or form of participation should be consistent with the requirements of the field situation, the characteristics and motivation of the farmers and the objectives of the irrigation agency.

THE RESPECTIVE ROLES OF FARMERS AND GOVERNMENT AGENCIES

One of the essential conditions for effective farmer participation is that

governments have a planned intervention strategy. Such a strategy should clearly define the respective roles that farmers and government agencies play as well as the contributions that are expected from each. The participants found it useful to enumerate the potential roles and contributions of farmers and government agencies. The understanding of the opportunities for farmer participation and of the support that governments can provide is essential to the design of an intervention strategy of a government agency seeking to promote farmer participation. The table below summarizes the outputs from the workshop discussion on the potential roles and contributions that farmers and government agencies can make. The first section relates to the planning, design and construction stages and the second refers to the operation and maintenance stage.

POTENTIAL CONTRIBUTIONS OF FARMERS AND GOVERNMENT AGENCIES

A. PLANNING, DESIGN AND CONSTRUCTION

Farmers' Contributions/Roles

1. To provide technical, social and economic information for use in planning and design.
2. To participate in decision-making on matters where farmers have recognized competence or a direct interest, e.g. tertiary system layout, crops to be grown, etc.
3. To provide labour for construction, where local skills and experience are adequate.
4. To secure rights of way for construction.
5. To assist in the control and supervision of construction activities to ensure quality standards.

Government Contributions/Roles

1. To promote and strengthen water users' organizations.
2. To propose and support legislation to promote water users' organizations.
3. To support the use of catalysts or change agents in developing water users' organizations.
4. To provide technical and managerial training for farmers.
5. To develop trainers and training facilities for building new skills among farmers and agency personnel.
6. To take the lead role in survey, planning, design and construction activities where specialized technical expertise is essential.
7. To formulate and present alternative system designs to farmers and to assist them in selecting the best alternative.
8. To use a flexible, but realistic, timetable for planning, design and construction.
9. To provide farmers with good maps of the irrigation system layout and facilities.
10. To design facilities and structures which farmers are capable of maintaining.

B. OPERATION AND MAINTENANCE

Farmers' Contributions/Roles

1. To assist in planning the system operation schedule.

2. To participate in planning and implementing system maintenance, including budgeting and scheduling decisions.

3. To assist in the collection of irrigation service fees.

4. To participate in the planning and monitoring of cropping patterns and water delivery schedules, etc.

5. To protect and preserve system facilities.

Government Contributions/Roles

1. To manage and maintain main systems effectively.

2. To provide agricultural inputs to farmers on time.

3. To support the use of catalysts or change agents to facilitate farmer participation and the development of local capacities for system management.

4. To provide information to farmers on expected water supplies, on water allocation and delivery schedules, and on the recommended cropping calendar, cropping pattern and cultivation practices.

5. To promote the sharing of experience, exchange of information, and productive interaction among farmers from different systems.

6. To provide training for farmers on system operation and maintenance.

7. To provide technical and/or financial assistance for farmers when the need is beyond the capability of the water users to furnish it.

The participants agreed that, as a general principle, government should avoid taking over responsibilities that the farmers can handle. They recommended a policy of providing only technical and managerial assistance for activities which are beyond the capacity of the farmers or their organizations. In addition, the participants encouraged governments to extend incentives and support to farmer groups that are trying to build their own capacities to manage irrigation systems.

(H) IMPACTS OF FARMER PARTICIPATION

Eight important impacts of active farmer participation in irrigation system planning and management were identified by the participants. These conclusions were based on the information presented in the case studies and on the experiences of the participants themselves. Although some of these impacts were noted as being more highly valued by government or by farmers, the impacts were all considered to be desirable and constructive. These were:

a. Increased crop production due to expansion in irrigated area and greater cropping intensity. The case studies demonstrated that farmer participation contributed to increases in area irrigated and cropping intensity. There was disagreement, however, on whether there was sufficient evidence to indicate that yields had increased as a result of farmer participation. Some participants felt that yields are influenced by numerous, complex factors and therefore the effect of farmer participation on yields would be extremely difficult to measure.

b. Improved relations and a reduction in conflict between government officers and farmers, and among farmers. The cases from South Asia and the Philippines indicated that farmer participation provided effective mechanisms or channels for ventilating grievances and for resolving conflicts. The frequent meetings and consultations between agency personnel and farmers resulted in fewer misunderstandings and allowed these key actors to settle differences through a non-confrontational process.

c. Increased collections of loan amortizations and contributions to labour and materials from the community. The involvement of farmers in planning system construction and management facili-

tated the mobilization of local resources. There is also initial evidence that farmer participation has encouraged water users to remit payments for construction loan amortizations on schedule.

d. **Improved water distribution and system maintenance.** The frequent interaction between agency personnel and farmers, and among farmers, resulted in more effective coordination in the allocation and delivery of water as well as in system maintenance activities.

e. **Willingness of farmers to accept responsibility for system operation and maintenance.** The involvement of farmers in decision-making from the initial phases of system development helped to generate their sense of ownership over the irrigation facilities. This sense of ownership, in many cases, gave farmers the confidence and the motivation to accept greater responsibility for managing the irrigation system.

f. **Improved system design and construction.** As farmers recognized their stake in having well-functioning irrigation facilities, they worked to ensure that system design and construction would meet their specific requirements and would be consistent with local resources and conditions. They contributed information on local hydrology, topography, agronomy, geology and climate which they believed to be useful in planning. They assisted in the survey work and facilitated the acquisition of rights-of-way. They helped to monitor the process of construction to ensure conformity with plans and quality standards. The result was a process of design and construction which took greater account of site-specific needs and conditions, and paid more attention to quality control. In short, farmer participation generated greater responsiveness to local conditions and underscored the accountability of government to the end-users.

g. **Improved agricultural management.** In several countries, farmer participation helped to create an environment for more effective coordination of agricultural services and farming practices. As farmers gained experience in decision-making and implementation, they acquired the essential skills for planning and executing system maintenance and water management. Farmer groups have also been applying these skills in other activities such as the coordination of planting schedules, the collective marketing of agricultural products, and community control of agricultural pests and diseases. Likewise, with the formation of farmer organizations, government agencies found, in these local groups, a point for coordinating the delivery of agricultural inputs and services.

h. **Other positive social changes with long-term implications.** The process of eliciting and promoting farmer participation resulted in other broad social benefits which contributed to the long-term development of the rural community. Some examples of these longer term benefits are the development of local leadership and organization, the enhancement of farmer skills and capacities to manage their own affairs and mobilize resources, and the promotion of mechanisms to express and articulate local needs and interests to the government sector. The experience of working with a government agency in the context of irrigation can impart to farmers the skills and confidence that they need in relating to external groups or institutions.

The benefits derived from promoting farmer participation, therefore, go beyond the immediate interests of both farmers and agency officials. The impacts not only cover the concerns for improved water management but also address the broader, more critical need for harnessing the full potential of rural communities and for building local capacities for self-reliant and self-sustaining development.

SITUATIONS WHICH ARE CONDUCIVE TO FARMER PARTICIPATION

There was a consensus among the participants that farmers can play a substantial role in irrigation system development and management. They recognized, however, that there are certain situations which are more conducive to farmer participation, and other situations where farmer involvement is most likely to be useful and effective where: (i) the rehabilitation or improvement of existing irrigation systems is needed; (ii) new system construction is contemplated in an area where a farming community is already in place; (iii) problems of poor management and inequitable water distribution are more prominent at lower levels than at the main system level; and (iv) group action is neces-

sary to secure a water supply either by new construction efforts or by participation in higher levels of decision-making.

In differentiating situations which would be more conducive or less conducive to farmer participation, the participants gave significance to four factors: (a) size and homogeneity of the beneficiary group; (b) the motivation of the farmers; (c) the motivation of the government agency; and (d) the technical complexity or sophistication of the task or decision.

a. **Size and homogeneity of the beneficiary group.** The organization or mobilization of farmers is easier to accomplish where groups are relatively small and homogeneous, and where farmers share common interests and needs. Such conditions are likely to be found in small irrigation systems, particularly those which are managed by the community, or in tertiary levels of large systems, where there would be strong interdependence among farmers. Correspondingly, farmer participation would be more difficult to achieve in larger systems where there would be a greater number of beneficiaries and more diversity within groups.

   Farmer participation may also be constrained in areas where large economic inequalities or strong cultural differences exist. Where there is great diversity in land tenure patterns, or in access to land, farmers may be less inclined to cooperate, because the potential benefits may not be shared equitably. Likewise, social or ethnic barriers may stand in the way of close interaction between farmers of different cultures.

b. **The motivation of farmers.** Unless there are clear and common incentives for farmers to become involved in irrigation development or management, efforts to promote farmer participation may be ineffective. In areas where water is already abundant and accessible to all, the water users have minimal incentive to participate in system operation and maintenance. Correspondingly, under conditions of extreme scarcity of water, there may not be any promise of clear and common benefits from organized efforts to allocate water or to perform maintenance work. The farmers who do have access to the scarce resource may see farmer participation as a threat to their continued enjoyment of the limited supplies. The farmers who currently bear the burden of scarcity may see only marginal benefits resulting from improvements in system operation and maintenance.

   Furthermore, water users may not be inclined towards farmer participation in situations where water management problems are seen as being beyond their control or influence. For example, in large irrigation systems where the main system is poorly managed by the government agency, there would be little incentive for water users to adopt more efficient water management practices at the tertiary level. If the main system is marked by inequitable distribution of water or unreliable deliveries, efforts to develop farmer participation at the tertiary levels would only generate frustration and disappointment among farmers.

c. **The motivation of the government agency.** Farmer participation is more likely to succeed when the benefits to government are likewise clear and substantial. In most cases, the direct benefit to government of farmer participation is the reduction of direct expenditure for construction or operations, due to contributions that water users can provide. In many cases, government budgets have not been adequate to cover the costs of operation and maintenance. There are also recent pressures to reduce the subsidies of the government to the irrigation sector. Under such conditions, irrigation agencies have greater motivation to permit and encourage farmer participation.

   There are also situations where several government agencies share responsibility for developing the irrigation sector. Cooperation between these agencies is essential. Rivalry, competition or hostility between these agencies can severely impede efforts to promote effective water management. Even if one agency seriously pursues farmer involvement, unless other related agencies are likewise motivated to support a participatory approach, a programme to mobilize farmers can easily be undermined.

d. **The technical complexity or sophistication of the task or decision.** Although farmer inputs in decision-making and system management are clearly advantageous, there are certain activities or tasks which require a level of

technical expertise or a perspective which farmers may not have. Consequently, in such tasks, it may be reasonable to set limits on the level of farmer involvement. The initial planning of large systems, for example, may not provide opportunities for farmer participation in decision-making, particularly in areas where the potential beneficiaries have not had prior experience with irrigation. Likewise, the design of main channel systems and large complex structures are primarily the domain of experienced engineers. However, beyond the level of the main system planning, farmers have substantial opportunities for participation in decision-making.

Finally, the participants also noted that farmer involvement may not be possible or appropriate in cases where the available water is required for several different purposes such as hydropower, domestic water supply and navigation. As such, the master planning of large-scale multipurpose projects may be best left to government planners.

ELEMENTS OF SUCCESSFUL EFFORTS TO PROMOTE FARMER PARTICIPATION

The Consultation also included a discussion of the elements which were common to successful attempts to increase farmer participation. These elements were drawn from the various case studies which were presented at the meeting.

a. **High-level government commitment to the principle of increased farmer participation.** The initiative, support and commitment of agency officials at the highest levels are critical to the success of programmes to increase farmer participation. The application of a new approach to irrigation development entails the investment of agency resources, the willingness to test different procedures in the field, the flexibility to alter existing procedures which may be incompatible, and the guidance, encouragement and moral support of an organization's leadership. These requirements can be realized with the firm backing of high-level officials. Without it, attempts to introduce a participatory orientation cannot hope to prosper.

b. **The use of catalysts.** A key element in nearly all the cases was the use of catalysts from outside the local community. These field workers are given different titles in different agencies - community organizers, change agents, institutional workers, etc. However, they all perform similar functions. These include, first, gaining acceptance in the community, then, assisting farmers in identifying their common problems and needs, and, eventually, developing local skills in organization and management. The objectives of the catalyst are to build the abilities of farmer groups to interact effectively with government, and to manage community resources collectively. It is important for these catalysts to have sufficient lead time to integrate themselves in the community and to facilitate the establishment of farmer groups, prior to involving the farmers in the irrigation activities.

Clearly, the role of a catalyst calls for individuals with the proper motivation, training and experience. Although it is possible for an irrigation agency to recruit or develop its own staff of community organizers, this requires a substantial investment of time and resources. Civil service regulations and rigid government budgets may also discourage the creation of new positions or the hiring of additional staff within the bureaucracy. A number of agencies have, therefore, opted to contract the services of external institutions that specialize in this line of work. This strategy has also been necessary in situations where poor communication or an antagonistic relationship exists between agency staff and the farmers.

c. **Clear incentives for farmer participation.** It is important for farmers to justify in their own minds, their involvement and participation. In order for them to be motivated to participate, the incentives for participation have to be visible, tangible and immediate. Where these are absent, it will be difficult to sustain farmer interest and involvement. Consequently, successful efforts at promoting farmer participation have emphasized the identification of common felt needs of farmers, and these needs have been used as entry points in mobilizing farmers. Increased access to water and more effective local control over limited resources are among the major incentives that farmers value.

d. **The close integration of technical and institutional activities.** Optimum results have been achieved in cases where the development of the irrigation system coincides and interrelates with the building of management capacities and organizational skills among the water users. The involvement of farmers in design and construction helps to ensure that the irrigation system will be responsive to local needs and conditions. At the same time, farmer participation in key decisions and tasks helps to build group solidarity, and to impart technical and social skills that are critical to the group's long-term effectiveness and survival. As such, the technical and institutional activities need to be closely coordinated and managed. This argues for teamwork and cooperation between technical and institutional staff - between engineers and community organizers. The physical and institutional aspects of irrigation development should not be seen as discrete tasks, but as integral and complementary parts of a programme to establish more effective irrigation and water management.

e. **A multidisciplinary approach.** The social, economic and technical complexity of irrigation systems calls for a multidisciplinary approach to problem-solving and decision-making. This need has been addressed, in many cases, through the harnessing of expertise from several disciplines. The collaboration of specialists from diverse fields such as engineering, sociology, management and economics has resulted in innovative and non-traditional approaches and solutions to field problems. Moreover, a multidisciplinary orientation can facilitate the integration of technical and institutional activities within projects.

f. **The learning process approach.** In many successful attempts to introduce farmer participation, the evolution of the appropriate strategy required several stages of experimentation and learning in pilot projects. At the start, each agency held the assumption that there was no ripe and proven formula for success, that a suitable process of generating farmer participation would have to be gradually developed and tested in the field. Pilot projects provided the laboratories for experimenting with alternative approaches and for building valuable experience and skills within the agency. The close monitoring and observation of the pilot experiments permitted the refinement of processes, systems and procedures until the agency was sufficiently confident in the effectiveness of the approach. Only then was there an attempt to replicate the approach in other projects or locations. Even during the expansion phase, field monitoring continued in order to generate lessons which shaped the efforts that followed.

FACTORS ENHANCING EFFORTS TO PROMOTE FARMER PARTICIPATION

In addition to the elements which are common to successful efforts to promote farmer participation, there are a number of factors which enhance or strengthen these efforts. The participants identified several of these factors:

a. **A clear set of goals and a sense of purpose.** Farmer participation is more easily pursued if its rationale or justification is clear to agency personnel and its leadership. Clear objectives provide direction to agency staff and are essential for effective decision-making at all levels. In order to generate acceptance of the principle of farmer participation, the logic of the principle should be spelled out and disseminated to all staff. Farmer participation may be less attractive as an end in itself, but can generate much enthusiasm and support if it is seen as a means to achieve a goal of great importance to the agency.

b. **Innovative, flexible risk-taking leadership.** A conservative, unimaginative leader can always find constraints which can keep a programme at a pilot level for far too long. Even if well meaning, a leader who is averse to risk will not make moves which may invite scrutiny or criticism. Such a manager can alone paralyse an effort to promote farmer participation. In contrast, a leader with an open mind and a disdain for bureaucratic impediments can spur a new programme beyond normal expectations. Such leadership can make resources available which could otherwise be beyond reach; he can shortcut procedures and red tape if they get in the way of essential activities; and he can encourage and motivate others through his willingness to step out in support of new initiatives.

c. **The assistance of a multidisciplinary working group.** A task force of individuals from diverse disciplines can play an effective role in monitoring and coordinating a process of institutionalizing a participatory approach within an irrigation agency. The context of irrigation is one where many complex technical, economic, social and managerial factors are at play. Rarely can a single individual analyse and comprehend the impact of these factors. However, a multidisciplinary group with a problem-solving orientation can offer valuable assistance and advice on the monitoring of field activities and processes, the extraction of lessons, the generation of alternatives, and the gradual expansion and institutionalization of effective approaches and supportive systems.

d. **External technical assistance.** The assistance of an outside institution or donor can be effective in many ways. In the same manner that a community organizer can serve as a catalyst in a rural community, an external institution can facilitate the process of reorienting an agency towards participatory approaches. It can provide resources which can give the agency the interest and confidence to test new methods without struggling with the normal bureaucratic or budgetary limitations. An external consultant can play a facilitator role in enlisting the support and involvement of key actors within an irrigation agency. The interest and enthusiasm of external institutions can motivate and encourage agency personnel to persevere in their pioneering efforts. Likewise, the backing of an external institution can often guarantee the survival of a participatory programme, especially in situations where the initial resistance to the new direction is significant.

e. **Flexible funding.** Many agencies that have embarked on a programme to promote farmer participation have found it advantageous, in the early stages, to maintain maximum flexibility in handling funds. In building agency capacities to implement a participatory approach, where a period of experimentation and experience generation is essential, an agency has to be able to respond swiftly to new conditions or situations. It has to have the freedom to shift resources around if necessary. Above all, flexible funding gives the agency the luxury of time, of not having to constantly seek approval from above for changes in schedules or budget categories, changes that are often required when the objective is to experiment and to learn how to be effective.

f. **The existence of cooperative action and mutual help activities.** Communities that have had a tradition of mutual help or labour exchange are usually more receptive to organizing efforts and to participatory approaches. Local experience in collective action is often indicative of community solidarity, the absence of major social tensions or conflicts, and a willingness to share in group tasks. Where such conditions exist, the job of the community organizer or irrigation engineer is generally less complicated and demanding.

g. **A clear policy of farmer ownership of the irrigation system.** Another factor which can enhance efforts to make farmer participation more effective is the existence of a clear policy of system ownership by farmers, before, during, and after project construction or rehabilitation. Such a policy can motivate farmers to become actively involved in decisions regarding the future of their system. A clear policy on ownership also shapes the character or tone of the relationship between the irrigation agency and the farmers. When an irrigation system is owned and controlled by government, the agency has the right to dictate how the system should be operated; farmers become mere recipients of government services. However, when it is firmly established that the water users are the rightful owners of the system, then the farmers have a clear stake in what happens to their facilities. Moreover, the agency, then, cannot decide unilaterally on how the system should be built or managed; it has to respond to the wishes of the system's owners, who are at the same time its direct beneficiaries.

FACTORS INHIBITING EFFORTS TO PROMOTE FARMER PARTICIPATION

There are, likewise, several factors which can inhibit or constrain efforts to promote farmer participation. Many of these are also potential causes for failure. They constitute the major pitfalls or obstacles that should be

avoided or controlled. At the minimum, it is important to understand how they each affect a participatory programme.

a. **Traditional bureaucratic patterns and attitudes.** Many government agencies have an inherent resistance to change, an inertia which prevents any radical departure from current procedures. Part of this inertia resides in rigid laws and regulations which are difficult to amend; but most of it is found in people's attitudes and beliefs - their aversion to risk, the high value that they place on security and stability. The most damaging resistance usually comes from those who feel threatened by new technology, new people, new tasks or new systems. Hence, the challenge is in managing the internal process of change, the process of gradually winning support from within, and the process of influencing behaviour and attitudes.

b. **Time pressures.** The participation of farmers in decision-making can be inhibited if rigid and unreasonable timetables and schedules are imposed on project activities. A programme that emphasizes farmer involvement cannot apply traditional project implementation schedules without the necessary adjustments. One important adjustment is the programming of sufficient lead time for the social preparation and organization of farmers. Moreover, each project should have a measure of flexibility to allow for discussions between farmers and agency personnel. When rigid schedules are imposed on farmers and on agency personnel, both groups will be under pressure to simply follow traditional modes of project implementation.

c. **A preoccupation with physical structures rather than with system performance.** An agency that gives greatest importance to the quality and timely completion of civil works and physical structures may unconsciously retard efforts to promote farmer participation. Agency systems should be geared to rewarding personnel for meeting targets in terms of physical accomplishment, rather than for an effective and functioning system, or for farmer satisfaction with agency services. Hence, in situations where the agency has to choose between institutional and technical objectives, it would abandon a participatory thrust in order to meet deadlines or to achieve high engineering standards. It is important to realize, however, that there does not need to be a tradeoff between institutional objectives and engineering objectives, but that the two types of goals can be entirely consistent and complementary. If an agency can take a longer term perspective where the goal is effective and sustainable system performance, then, clearly, farmer participation and proper system engineering are equally important and essential.

d. **Agency organizational structures and systems that are unresponsive to farmers' needs.** An agency that is promoting farmer participation will often find that its existing systems, structures and incentives are inconsistent with a participatory thrust. For example, performance may be measured purely in terms of kilometres of canals constructed and the number of farmers benefited; such criteria may reward attention to costs and physical output, but may ignore efforts to build local skills and capacities. A budgeting system may be oriented towards the control of costs but it may not permit the flexibility to respond to site-specific needs and concerns. In order to realize the full potential of farmers' participation, the agency must ensure that its systems and procedures are designed to respond effectively and appropriately to farmers' initiatives and needs.

e. **Frequent transfers of government officers.** The effect of this factor is evident. When frequent transfers of agency personnel take place, it is difficult to manage a process which aims to develop people rather than simply concrete structures, a process which needs a longer time horizon. Given these objectives, the continuity of management style and vision becomes very important. Moreover, the irrigation context is often so complex and diverse that familiarity with the local situation and its unique circumstances is essential. With frequent personnel transfers, a lot of time can be lost just on the process of orienting the new staff to the programme objectives and to the local conditions.

f. **Dependence on a handful of key individuals.** The commitment to and support for a participatory programme may be concentrated in only a few individuals within an agen-

cy. During the early stages of a programme, a minimal level of support may be all that is required. Once the programme seeks to expand, support will have to be generated from other levels and sections in the organization. The danger of excessive dependence on a few key individuals is also that the programme may not survive if these individuals leave the organization or if their support wanes.

g. Rapid turnover of organizers. In many agencies that have undertaken a participatory approach, the position of the community organizer has been a temporary or a contractual one. Although several agencies have tried to establish permanent positions for these institutional workers, there are numerous bureaucratic hurdles to overcome before obtaining approval. As a result, most community organizers are hired on short-term contracts with no security of tenure and few opportunities for advancement. The field work itself may be extremely rewarding for the community organizers, but the hiring arrangements often provide the organizers with little additional motivation. As such, it is not uncommon for community organizers to leave for different jobs midway through a project. Another issue surrounding the contractual nature of the CO position is the incentive of the CO to withdraw from the community at the proper time. The job of the CO is usually considered as completed when the farmer organization is prepared to stand on its own without the assistance of a facilitator or a catalyst. However, the CO may have little incentive to perform and complete this task if that will mean terminating his employment and his source of income. The contributions and skills of a community organizer are recognized as valuable and significant. However, current employment practices in government do not reflect this.

h. Lack of knowledge or skills to implement a programme of farmer involvement. The vital skills to implement a participatory programme may not be available within the agency. There are, for instance, some countries which have had no previous experience or history in community organizing and only a few individuals with backgrounds in social work or community development. The absence of such resources, in the short term, may limit the scale of the programme or may require the importation of the expertise.

i. Social and geographic impediments. There are also a number of site-specific factors which may inhibit the involvement of farmers in irrigation development. These factors will vary from location to location; however, they can spell failure even for the most well-conceived approach. Some of these factors are: (i) land tenure patterns which lead to conflict between different groups in a community; (ii) the presence of a high percentage of part-time or non-resident farmers which can make it difficult for the group to even call a meeting; (iii) the dearth of farmer leaders which can prolong the social preparation period; (iv) strong cultural differences between ethnic groups; and (v) the existence of civil or political groupings which cut across irrigation communities.

RECOMMENDATIONS

During the final sessions of the Consultation, the participants formulated specific recommendations for action. These recommendations were addressed to two key actors in the field of irrigation development: government agencies and donor institutions. Included under the category of donor institutions are multilateral and bilateral institutions financing development, private foundations, and international organizations that provide technical assistance. The recommendations addressed to each type of actor are presented below.

RECOMMENDATIONS TO GOVERNMENT AGENCIES

The participants recognized that government has to play the primary role in introducing and promoting farmer involvement in irrigation development. Unless government is truly supportive of this thrust, external initiatives to develop farmer participation will not go far. The lead role, as the prescriptions below demonstrate, is a demanding one. The backing of agency staff, especially at the highest levels, is essential. Likewise, resources will need to be

invested, procedures and policies will have to be reoriented, and new and untamiliar approaches will have to be tested. It is, therefore, a role that requires a major commitment on the part of the irrigation agency.

The participants formulated four major recommendations for government agencies that want to strengthen and promote farmer participation in irrigation programmes.

1. Government should take steps to develop the commitment of agencies and agency personnel to farmers' participation.

At present, different countries have varying degrees of commitment to the objective of actively involving farmers in irrigation development. Moreover, there is a lack of understanding on the part of key personnel of the principles, concepts and approaches underlying farmer participation. As such, there is a visible reluctance to change, and sometimes this manifests itself in direct resistance to efforts to include farmers in the decision-making and planning processes. There is, therefore, a need to generate a better appreciation of the impact or benefits of farmer participation, and likewise to strengthen government commitment to this thrust. One approach would be to expose key personnel to successful experiences with farmer involvement. This could be accomplished through conferences, workshops, or field visits to actual project sites. The generation and dissemination of concrete evidence on the advantages of farmer participation would also be important.

2. The irrigation agency should undergo a process of building its own internal capacity to actively promote and sustain farmer participation.

Although a strong commitment to pursue farmer participation may exist, in many cases, the government agency lacks the specific knowledge, skills or capability to promote farmer involvement in irrigation. The case studies that were presented at the Consultation demonstrate that irrigation agencies can undertake a process to develop these skills and capabilities within their own organizations. This process requires several key elements:

a. The establishment of pilot projects to experiment with alternative approaches for involving farmers. These projects would serve as learning laboratories where different strategies could be tested and refined in field situations.

b. The formulation of a multidisciplinary working group composed of committed individuals within the agency, supported by specialists from external institutions. This task force would have the function of managing the learning process - of monitoring and reviewing the activities in the pilot projects, of extracting lessons from these learning laboratories, and of planning the action steps required to disseminate the experiences and lessons from the field experiments. For example, a key activity of the working group would be the identification of the specific opportunities for farmer involvement in project planning, design, construction and operation. The experiences from the pilot projects would permit the group to determine specifically where, when and how farmers can participate effectively in the irrigation development process.

c. The review and revision of government policies or laws, as well as agency procedures or regulations, in order to ensure that they are consistent with the participatory thrust and to enable water users associations to have a legal standing. The agency should also focus its attention on the legal or procedural constraints to farmer participation. It would be necessary to review agency policies, procedures and management systems in order to make them consistent with a participatory thrust. National laws or policies which inhibit farmer participation should likewise be evaluated and revised. This would include examination of the policies on the water rights of farmer groups, and the rights of farmers to form organizations to pursue common interests.

3. The coordination of government agencies involved in irrigation development should be improved.

In several countries, irrigation development is the responsibility of more than one agency. In many instances, the roles of these agencies are unclear, overlapping or conflicting. The unintended victim is often the farmer who bears the costs of poor coordination and inefficient delivery of services.

The participants formulated several

specific recommendations to address this concern. First, the coordinating procedures among related agencies should be reviewed and rationalized. Second, the respective tasks and responsibilities of the different agencies should be clearly identified in order to reduce areas of overlap and potential conflict. Third, coordinating committees with representation from the different agencies should be established at all levels, from top management to the field level, in order to ensure close consultation and exchange.

4. Programmes and courses to orient and train agency personnel in the application of the participatory strategy should be conducted at all levels of the organization. Farmers should also undergo training to develop the special skills required for their effective involvement in system construction and management. The design and conduct of training programmes should, as much as possible, be also conducted in a participatory manner.

The need for training was stressed by the participants. Training was seen as an important means of generating commitment and support for a participatory strategy. It was also viewed as essential in building the required skills and values among agency personnel at all levels. At the level of senior agency officers and executives, workshops, conferences and study tours can expose these key decision-makers to alternative approaches and provide them with new insights into irrigation development. The exchange of views between senior-level agency officials can further strengthen their commitment to farmer participation.

At lower levels in the organization, training programmes can also reinforce individual commitment to the participatory strategy. It can also develop clearer understanding of the concept of farmer participation and impart essential skills and knowledge. At the level of the water users, training will also be necessary. Farmer participation in such activities as design, construction and system operation may require not only basic technical skills but also organizational and management skills.

Training programmes should be developed in a participatory manner. First of all, the involvement of prospective trainees in the design and conduct of the training programmes helps to communicate and demonstrate the true nature or sense of participation. The experience of participation helps to impart to the trainee the value of and rationale for involving the beneficiaries of development projects. Secondly, the handling of training programmes in a participatory manner ensures that the courses are appropriate to the needs of the trainees and relevant to the local situation. Although various training materials from other countries or institutions may be available, they may not address the specific concerns or needs of the target group of participants, or may not be consistent with the overall goals of the agency.

RECOMMENDATIONS TO DONOR INSTITUTIONS

The financial and technical assistance from donor institutions and international organizations is an important element in national programmes to increase farmers' participation in irrigation development. More specifically, the assistance of donors can be of great value in building up agency capacities to undertake participatory approaches. The participants recommended that donors:

- provide support within a framework of promoting an integrated approach to irrigation development.

  Successful efforts in irrigation development are characterized by a balanced consideration for technical, social, economic and institutional factors. From the conceptualization of the irrigation programme or project, the optimal integration of these complex factors is essential. Donor support for irrigation should, therefore, channel resources in a manner consistent with an integrated approach to irrigation development. Donors should avoid placing excessive emphasis on one set of factors to the neglect of others which may be equally important.

- be willing to provide long-term support for national programmes which develop participatory capacities and skills in irrigation agencies.

  Apart from the support that donors provide for specific projects, they should also be willing to assist in national programmes to develop agency capacities. Donor assistance in this area can be directed to such elements as the establishment of pilot projects to develop and test new approaches, the monitoring and evaluation of these experiments, the design and conduct of training programmes for

different target groups, and the involvement of external resource institutions in the capacity-building process.

The development of new capacities in government agencies requires a longer time horizon than the discrete projects that most donors are accustomed to supporting. Moreover, donor agency planning and budgeting systems are usually designed to handle specific projects rather than to support a process of internal capacity-building. The participants emphasized that donors should begin to shift part of their support to longer-term programmes that focus on institutional development. The consensus of the group was that assistance of this nature would be extremely important and timely. Unless irrigation agencies are able to acquire the essential skills and capacities to work effectively with farmers, the potential benefits from their projects may never by fully realized.

- support the dissemination of information and the transfer of experience between countries.

The sharing of experiences and the exposure of key individuals to the efforts in other countries can be a powerful mechanism for generating commitment to and support for farmer participation. It can also facilitate the transfer of successful techniques and strategies to agencies that are trying to develop their capabilities. Donors can assist in this process by organizing such activities as study tours, conferences, workshops and seminars. Consultancies which involve the exchange of personnel among agencies would also be worthwhile supporting.

- promote effective cooperation among national agencies and among researchers and practitioners involved in irrigation development.

Donors can play a catalyst's role in bringing about more productive coordination between agencies that have related or complementary functions, such as agencies involved in agriculture and irrigation. Donor support can also generate opportunities for interaction and collaboration between development practitioners and academicians who work in similar fields. Close coordination between agencies is essential for more efficient delivery of services to the farmer and for more effective responses to local-level needs. Likewise regular interaction between scholars and practitioners can lead to research and educational programmes that are more relevant and practical, and to development work that is more aware of, and sensitive to, the complex issues and alternative perspectives that merit consideration.

- encourage the establishment of national policies that support active farmer involvement in irrigation development.

Although national agencies can themselves initiate changes in policies or new legislation which will provide an environment which can be conducive to farmer participation, the additional support and endorsement from donor agencies can often facilitate action on the part of policy-making bodies. Such intervention, however, may also be interpreted negatively and, therefore, donor agencies will need to proceed carefully and only after consultation with the national agencies concerned.

- examine and pursue increased consultation and collaborative efforts among donors.

There are many different types of donor institutions that provide assistance for irrigation development. Each type of donor has its relative strengths and weaknesses. Some donors, for example, are only able to extend technical assistance; a few are able also to contribute the services of a facilitator who can mobilize needed resources from other institutions and assist in shaping the capacity-building process within the agency; others excel in their ability to handle their funds in a very flexible manner.

Donors should begin to examine how they can work together to take advantage of their comparative strengths. Collaboration between donors can result in a more appropriate and complementary mix of external support, especially for programmes which have long term, institutional development objectives.

- allow for flexibility in funding arrangements in programming procedures and in project implementation schedules.

There are occasions where rigid

donor policies and requirements can pose obstacles to farmer participation and can reduce the responsiveness of the irrigation agency to local needs. For example, strict adherence to sophisticated engineering methods may leave little room for farmers to participate in design decisions. Inflexible project budgets may not allow an agency to react quickly to site-specific problems. A tight implementation schedule that is based purely on technical considerations may pressure an agency to minimize farmer involvement and to approach the project in an autocratic fashion. There is always the danger that particular policies or procedures may generate the type of behaviour or approach which contradicts the objectives of farmer participation.

Donor agencies should, therefore, evaluate their own procedures and policies to ensure that these are consistent with agency efforts to promote farmer involvement.

- simplify approval procedures and attempt to reduce the time required for processing the requests for assistance.

The participants urged donors to examine ways and means of shortening the lead time for securing approvals and of simplifying their internal procedures. The participants felt that a reduction in the so-called 'red tape' within donor institutions would lead to more effective collaboration, and would enable irrigation agencies to become more responsive to their clients.

PART II

TECHNICAL DOCUMENTATION OF THE MEETING

- CASE STUDIES
- COUNTRY PAPERS

WATER USERS' ASSOCIATIONS IN INDONESIA

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1. BACKGROUND

1.1 General Information

Indonesia is highly diversified in both culture and resources. It is composed of 13 677 islands with a total land area of 4 497 214 km². Its climate is tropical and average rainfall ranges from 700 to 3600 mm/year. Its topography is dissected by 39 major rivers. As such, irrigated agriculture is of primary importance in the production of food for its population of 150 million.

According to the Central Soil Research Institute, the total arable land area of Indonesia is 162.658 million ha, consisting of 39.291 million ha of lowland area and 124.044 million ha of uplands. The upland areas are primarily concentrated in Sumatra (47.363 million ha), Sulawesi (19.095 million ha) and Irian Jaya (42.200 million ha).

Rice is the dominant crop in Indonesia. In 1982, 9.022 million ha were devoted to rice production, 4.780 million of which were on the island of Java. Wet rice agriculture accounts for almost 95 percent of total rice production in Indonesia; in 1982, around 8.173 million he were under sawah or wet rice agriculture. The average growth rate of the area devoted to sawah was 1.99 percent/annum between 1968 and 1982, compared with the 1.68 percent/annum rate of growth of the total area devoted to agriculture.

Rice production has shown remarkable progress over the past decade. In 1968 and 1982, the average rates of growth in rice yields were 4.4 and 3.3 percent/annum, respectively. Output growth in recent years has also been spectacular. For example, between 1978 and 1982, the average annual rate of growth in output was 6.1 percent. Between 1979 and 1980, it was 12.8 percent.

The determinants of increasing rice production are difficult to identify precisely, but since 1968 about one-quarter of the growth in output can be attributed to increases in area harvested; the remainder can be attributed to yield increases. The growth in area harvested may be due to either increases in sawah hectarage or to improvements in cropping intensity. Increases in yields may be attributed to a number of factors, all of which exert complementary and synergistic influences on yields - quality of irrigation, fertilizer use, rice varieties, crop management, special intensification programmes, and cooperation among farmers. Between 1972 and 1981, the relative influence of these factors on growth in output was as follows: 16 percent due to the quality of irrigation, 5 percent due to improved rice varieties, 4 percent due to fertilizer use, and 75 percent due to the interaction of these variables.

Irrigated areas in Indonesia are classified on the basis of irrigation facilities, management responsibility and size of irrigated area.

On the basis of quality, there are three basic categories - technical systems, semi-technical systems, and non-technical systems. Technical systems are those which have a water supply system separated from the drainage system, and where the volume of incoming water delivered can be regulated and measured at a number of points. Semi-technical systems have fewer permanent structures, have only one water measurement device (usually at the major intake) and have incomplete separation of water supply and drainage systems. Non-technical systems have no water management device, and have facilities which are used simultaneously for water supply and drainage which may result in recirculation of water.

Systems are also classified on the basis of management responsibility, whether the system is administered by government or by a non-government organization. Medium and small (simple) irrigation systems are under the control of the Ministry of Public Works. Small irrigation systems are usually between 200 and 2000 ha while medium irrigation systems range from 2000 to 10 000 ha. Village irrigation systems also vary in area but are managed, operated, maintained by the village, either through local authorities or through community organizations.

The regional distribution of irrigation service areas is shown in Table 1.

Table 1 SUMMARY OF SERVICE AREAS OF EXISTING IRRIGATION SYSTEM

Island	Area (000 ha)	
	Total Plains	Total Irrigation
Java and Bali	3 039	2 699
Sumatra	27 648	659
Kalimantan	24 544	149
Sulawesi	3 157	342
Nusatenggara	653	252
Maluku	1 226	1
West Irian	18 718	0
TOTAL	78 985	4 102

Source: Indonesia, Policy Options and Strategies for Major Food Crops, April 1983.

These figures underscore the importance of irrigation to agricultural production in Java. With only 7 percent of the land area, Java and Bali account for about 60 percent of the irrigation service. Java and Bali are endowed with the best soils for irrigated rice production and support about 66 percent of the population. The extent of irrigation areas is, therefore, in reasonable balance with the broad distribution of population. However, the productivity of sawahs in Java and Bali is greater than in the other islands.

The Ministry for Public Works has the overall responsibility for irrigation, and the Directorate General of Water Resources Development has the major responsibility for designing and constructing irrigation systems. Operation and maintenance (O&M) of irrigation systems down to the tertiary outlet has traditionally been the responsibility of the Provincial Public Works Services. Beyond that point, farmers, through their various organizations, are responsible for O&M.

Irrigation management began when sugarcane cultivation was started in Java in the 18th century. Several irrigation schemes were constructed during this period, such as Pemali Comal Irrigation System, Cirebon Irrigation Scheme and the Pekalen Sampean and Glapan Sedadi Irrigation Systems in Java. After sugar began to be exported, the Dutch Government started to improve and to increase the farmers' rice production. Before that time, water distribution for paddy was only of second priority after sugarcane (day time for sugar and night time for paddy crops). However, the regulation was then changed, and today the cropping intensity and cropping patterns in Java are much higher and much better than in other areas. Also the water user associations and farm-level water management in Java are the most advanced in Indonesia (with the exception of Bali). The ulu-ulu (water master) system has been effective and the yield, production, and income of farmers are higher in Java than in other areas.

Since the first of the Five Year Plans (Repelita I, 1969-1974), improvements have been made in existing irrigation systems, including those which had been established in the 18th and 19th centuries. The development of new irrigation systems outside Java has also been carefully carried out. The rehabilitation and development activities cover water supply, water distribution, water management and such issues as personnel, training, and administration. However, the involvement of farmers in the general planning, design and construction of the irrigation system was often neglected.

Coordination in irrigation management at the local level is achieved through an Irrigation Committee. It is composed of the Governor as the committee chairman, the Irrigation Service Chief as the secretary, and the head of the Agriculture Service and the head of the Agrarian Service as members.

The following sections describe the four models of irrigation organization and farm water management in Indonesia:

- the Subak irrigation system;
- the Village irrigation system;
- the ulu-ulu desa or Village Water Master irrigation scheme; and
- the management of the tertiary level of a larger irrigation system.

Specific case studies of each model are presented in order to illustrate the unique practices and characteristics of each type.

The Subak Irrigation System

The Subak is an indigenous community organization found in Bali. Subak irrigation systems are managed and operated entirely by farmers; it is also completely independent of the village administration. The main objectives of the Subak are to provide equitable water distribution, to maintain and improve the irrigation system, to increase food and crop production, to increase the members' well-being, and to organize the social, economic and religious activities of its members. The Subak is a multi-purpose organization, but agricultural production is its primary goal.

The case study is on the Medewi Subak in Bali, a 280 ha system located in Pekutatan Kecamatan, Jembrana Kabupaten. The Medewi Subak was built by the farmers of Medewi Village in 1926. In 1939, the system was reported as irrigating 162 ha. The system consisted of a 0.272 km tunnel from the intake, an open main canal of 1.934 km, 0.010 km of drainage canals, 0.238 km of secondary canals, and 4.630 km of tertiary and quarternary canals. System facilities include four division boxes and one siphon.

The general planning, design and construction of the system were done through mutual assistance by the farmers, without any assistance from

the government. They have also remained entirely independent in terms of operation and maintenance activities.

The Village Irrigation System

The traditional village irrigation system is managed by the farmers themselves. However, the government may have been involved in the construction or rehabilitation of the system. The case study is on the Glonggong irrigation system, situated in Gondang Kecamatan, Sragen Kabupaten. This system, which irrigates 287 ha, is located at the foot of Lawa Mountain, around 95 m above sea level. The water supply flows from the Winong barrage, located on the Sanur River in the Tangul Village; the Glonggang system shares this water supply with the villages of Tanggul and Godang; the basic facilities consist of 15.180 km of tertiary canals, 2.0 km of quarternary canals, and 21 division boxes, without any measuring devices. The water discharge is 100 l/s during the wet season and 100 l/s in the dry season. The system was built in 1936, first rehabilitated in 1953 and rehabilitated a second time in 1972.

The planning, design and construction of the system were done jointly by both government and farmers. The weir and part of the main system were built by the government, while the tertiary facilities were completed by the farmers by mutual assistance.

The system suffers from a shortage of water during the dry season, and this has been a source of conflict among farmers. These difficulties in water management provided the impetus for the establishment of a new water users association in 1973. This positive step was also supported by the Agricultural Service which provided technical assistance and training to farmers on on-farm water management. The members of the organization were further encouraged to improve their water management practices in 1975, when the neighbouring village of Tanggul won the agency-sponsored provincial water management competition. The assistance of the Agricultural Service as well as the close coordination of the associations with their neighbouring water users' groups have permitted the Glonggong system to enlist the full participation of its members in water management.

The Ulu-Ulu Desa Scheme

The Ulu-Ulu Desa (village water master) scheme refers to the practice of placing overall responsibility for irrigation system management in the hands of one or more special village officials. What commonly evolves is a single purpose organization within the community charged with the operation and maintenance of the village irrigation system.

Two case studies are presented under this category. One is the Mitra Cai water users association in Cirebon Kabupaten. This association is a union of two neighbouring associations - Beberan Mitra Cai and Serang Mitra Cai - which together account for 74.9 ha of lowland irrigated area in two villages. This area is part of a larger irrigation system that irrigates 4602 ha, built by the Dutch in 1905.

The other case study is on the HIPPA water users association of the Pekalen Sampean Irrigation System in Jember Kabupaten. This association is responsible for 156 ha of irrigated area.

The Mitra Cai association was chosen for study because of its use of a unique system called the Mayoran system. Under this system, there are two key officials involved in irrigation activities. The first official, the Raksabumi, is a village official who has responsibility for all agricultural and production-oriented activities. The second key official, the mayor, is responsible for managing all irrigation system O&M work. Both officials work closely with each other.

In the Beberan-Serang system, dry season water supply is inadequate for irrigating all the crops planted. The Beberan-Serang service area is irrigated by one tertiary outlet. 2.3 km of tertiary canals, 0.4 km of quarternary canals and three division boxes.

The HIPPA water users association is located in one of the villages within the Daerah Irigasi (Irrigation Area) Mayang, Jenggawah Pengamar, Pengavian, Jember Irrigation Section. The association is responsible for 156 ha of a 226 ha system which draws water from the Jalang river. The system facilities consist of a weir, built in 1912, one tertiary outlet, one division box, 3.2 km of tertiary canals and 0.3 km of quarternary canals.

In both systems, the farmers are well motivated and maintain good relationships with the Agriculture Service of the Government. The Agriculture Service has actively promoted water management with the use of a manual, a system of training and visits, and regular competitions between water users associations.

The Tertiary Level Water Management System

The fourth model of farm water management involves the appointment of a tertiary water master or ulu-ulu vak who has overall responsibility for water management at the tertiary level. Each tertiary level unit is around 100 ha in area and may go beyond the boundaries of villages. The size of the tertiary and the appointment of a single responsible individual permit fast and efficient communication of instructions or information within the irrigation system. To some extent, the tertiary level water master scheme also reduces the potential of operational problems arising from social or political conflicts and interests within the village.

The case study involves the Tirto Mulyo Dharmatirta, a 67 ha tertiary within the 9080 ha Gung Irrigation Area, which was developed in 1927. The 67 ha tertiary spans two villages - 53 ha in Sindang village and 14 ha in Pagiyanten village. The tertiary is served by one tertiary outlet, 2.7 km of tertiary canals, 0.4 km of quarternary canals, and one diversion box. The design and construction of the main system was accomplished by the government; the tertiary facilities were developed by the water users. Today, the management at the tertiary level is coordinated by the ulu-ulu vak with the assistance of the ulu-ulu desa from Sindang village and from Pagiyanten village. A special crew of workers from the villages is also involved in the regular maintenance activities.

In this tertiary area, conflicts over water occur during the dry season when there are shortages. The discharge during the dry season falls to 65 l/s as compared with the wet season average of 92 l/s. The Agriculture Service in the area is also active in ensuring that all necessary agricultural inputs are available.

Table 2 gives the descriptions of the irrigation systems of the case studies.

Table 2 IRRIGATION SYSTEMS OF CASE STUDIES

Case study	Type of Irrigation System	Irrigated Area (ha)	Technical data
Medawi Subak	Farmers Irrigation System	280 (Bali Province)	Built in 1939 0.272 km tunnel main canal 1.934 km open main canal 0.010 km main drainage canal 0.238 km secondary canal 4.630 km tertiary and quarternary canal 4 division boxes, 1 siphon
Glonggong Dharmatirta	Village Irrigation System	287 (Central Java)	Built in 1936 15.180 km tertiary canal 2.0 km quarternary canal 21 division boxes
Beberan Serang Mitra Cai	Village Water Master System	74.9 (West Java)	Built in 1905 2.30 km tertiary canal 0.40 km quarternary canal 3 division boxes
Jenggawah HIPPA	"	156.0 (East Java)	Built in 1912 3.2 km tertiary canal 0.3 km quarternary canal
Tirto Mulyo Dharmatirta	Tertiary Water Master System	53.0 (Central Java)	Built in 1927 2.7 km tertiary canal 0.4 km quarternary canal

1.2 Common Problems

The common problems faced by each of the four cases vary from the technical and socio-economic aspects to the institutional and agricultural aspects.

i. Inadequate physical structures, incomplete canal systems and insufficient water supply are common problems which result in virtually limitless water supply at the head of the systems and untimely deliveries at the tail end. These problems generate conflict between farmers at the head and tail, and between vil-

lages. This situation has also adversely affected cropping patterns and agricultural production. Where there is an absence of a functioning water users association and a lack of water rotation at the tertiary and quarternary levels, water distribution will be inequitable and conflicts will exist.

ii. Irrigation engineers have limited knowledge of water users associations and farm water management. They possess skills and expertise in construction and, therefore, are predisposed to assess problems and solutions in terms of the physical structures and engineering specifications rather than in terms of farm water management or institutional factors. Farmers are seldom represented in the irrigation committees that formulate plans for construction or system operation. Most of the information flows are upwards and are concerned only with the security of the phsyical structures rather than with the needs of farmers and their crops. The situation is further complicated by the existence of large centralized bureaucracies which are responsible for system operation and water distribution.

iii. Although farmer participation in system management is important, the Irrigation Service personnel have little knowledge of or experience in identifying farmers' needs and in organizing farmers into water users associations. The case studies show that 59 percent of farmers in irrigated areas are small farmers and tenants, which may make the organizing process more difficult. Today, very few of the large irrigation projects or systems have incorporated farmer involvement in project design and management.

1.3 Specific Problems

The case studies also revealed several problems which are specific to particular situations and areas.

i. With the exception of the Subak and Glonggong Dharmatirta, the systems that were investigated all exhibited incomplete planning and design of tertiary facilities. The explanation for this was the inadequacy of farmer participation in the design and construction stages.

ii. The tertiary designs did not permit the operation of the system for diversified cropping patterns using paddy, secondary crops and sugarcane. This was particularly evident in Mitra Cai and HIPPA.

iii. High siltation was observed in Mitra Cai and Beberan Gerang which will make it difficult to operate and maintain these systems.

iv. In the Subak case, unlimited supplies of water are available. This may lead to poor maintenance of facilities, given that the delivery of appropriate and reliable amounts of water is a precondition for effective community mobilization and action for system maintenance.

2. PROGRAMMES TO INVOLVE FARMERS

The four case studies of farm-level water management in Indonesia are examined within the context of farmers' participation and involvement in irrigation management. Special attention is given to the aspects of traditional organization, government intervention and organizational linkages.

2.1 Farmers' Participation and Organization

The Medewi Subak

The Subak is the indigenous, agro-socio-religious organization based on the Balinese traditional common law. Subaks have existed for centuries and have maintained their basic structure, incorporating elements from each of the different regimes. According to the anthropologist Dr R. Goris, the Subak system was established at the time when the traditional system of sawah agriculture was developed. During the 11th century, the Subak system was already well known. The word "Subak" is derived from the word "Seuwak", meaning "good water distribution". In the Bandung district, the work "Subak" means "water distribution to a farmer's sawah field". In Jembrana, the word comes from the term "Suba Karma", meaning "good deed".

The Medewi Subak is composed of irrigated rice farmers who draw water from the Yeh Satang River. The borders of the Subak are based on the boundaries of the irrigation system service area and do not correspond to the political or village boundaries. The Subak is an autonomous and democratic organization. Consultation with, and parti-

cipation from, rank and file members are important features of the Subak decision-making process.

The primary objectives of the Medewi Subak are to distribute irrigation water in an equitable manner, to operate, maintain and improve their irrigation system, to coordinate agricultural activities and practices (cropping calendar, cropping patterns, etc.), and to organize the religious affairs of the community. The Mewewi Subak is, like other Subaks, a multi-purpose organization.

The Subak is completely independent of village administration; it has its own laws, called the "awig-awig".

The awig-awig is an indigenous set of laws and dates back to the period when kings reigned in Bali. There are cases, however, where the awig-awigs have been revised by local government authorities. In many Subaks, the awig-awig is preserved on a dried palm leaf written in old Balinese language; in others, the awig-awig is passed on through oral tradition. The awig-awig enshrines the general traditions of the Subak - the religious and social principles, norms, fines, water distribution rules, lists of key officials and their responsibilities, meeting rules and schedules, funds, management policies, rules on membership and coordination between Subaks. Changes in the awig-awig must be approved by the Subak membership in a meeting. Only rarely are changes made in order to standardize the form of the various awig-awigs, rather than to change the basic content.

The chairperson of the Medewi Subak is elected on the basis of merit. His role is to mediate between the Subak and the various government agencies. Above him is the Sub-district Coordinator; above him is the regency coordinator. Both are appointed by the regency head and have civil service status.

The meeting times of the Subak are specified in the awig-awig. In some cases, there is no fixed schedule and meetings are called by the Sub-district Coordinator. During the meetings, the members, who all have equal rights to vote, discuss work plans, water distribution, cropping patterns, religious ceremonies, tertiary development, etc.

While a farmer may be a member of more than one Subak, he or she must recognize the obligations to each. The main obligation is the individual contribution to the collective works done by all members for the benefit of the community as a whole. Collective work is compulsory, but is organized in a democratic manner. Failure to fulfil the obligations of a member is punished by a fine.

The Medewi Subak was established to provide relatively small and independent water sources for irrigation. The obligation of each Subak member is to participate and be involved in all aspects of system construction, operation and maintenance. Members have to follow the Subak rules and regulations, to pay fines, to make contributions and to pay the land tax. Each member has to provide a contribution to the collective work in proportion to the service received from the Subak. Those with more land and who therefore receive more water have a greater obligation to the Subak. If a member is unable to participate directly, he is required to send a friend or relative in his place. In general, the most common offences which are punishable by fines are: illegal water consumption, disregard of the collective work, absence at meetings, damage to irrigation structures, and failure to observe the cropping pattern. The heaviest fine is for irrigation structure damage. In 1982, the fine for this offense was Rp. 12 500. Failure to pay the fine usually results in a doubling of the fine and, in the case of continued refusal to pay, in a cut-off of water delivery to the delinquent member.

In the Medewi Subak, religious ceremonies accompany all the major agricultural activities. Ceremonies are held at the start of land preparation, before transplanting, when water is delivered to the first sawah field in the wet season, and on other occasions.

The Village Water Master or Ulu-Ulu Desa System

There are two cases examined under this type of farm water management: Beberan-Serang in Cirebon and Jenggawah HIPPA in Pekalen Sampean.

The most common type of farm-level water management in Indonesia is based on a system using village water masters. In Central and West Java, the water master is called "Ulu-Ulu Desa"; in East Java, "Jaga Tirta"; in North Sumatra, "Raja Bondar"; and in West Sumatra, "Tuo Bandar". He is usually appointed by the Village Chief, with the consent of the Camat (Subdistrict Head), and is therefore part of Village Leadership or "Pamong Desa". He is responsible for the O&M of all types of irrigation systems in the

village boundary, particularly the mobilization of communal labour to maintain, repair and improve the irrigation system; the distribution of irrigation water equally; and communication with the village chief and government officials. His responsibility is determined by the administrative boundaries of the village and not by tertiary irrigation system.

In the case of Beberan Serang Mitra Cai, the village water master is called "Mayor Cai" or "Pembanyon" and he is subordinate to the "Raksabumi" or "Ngalambang" (village official who has responsibility in agriculture and prosperity acitivities). The Mayor Cai has several workers to work with the O&M of irrigation systems in their village. Together with the Raksabumi, the Village Chief and the farmers in the village plan the irrigation system improvement, operation and maintenance. The design is done by Mayor Cai supervised by Juru Pengairan. The implementation of the construction is executed by Mayor Cai and his workers. The O&M of the system is implemented by the Mayor Cai and his staff.

During the programme for tertiary rehabilitation implemented in 1975, an attempt was made to organize the farmers of Mitra Cai. Because the responsibilities for irrigation management were vested in a few village officials, there was an absence of an active and fully functioning water users association in Mitra Cai.

During implementation of tertiary rehabilitation and development, the principle of farmers' involvement in the planning and design process was difficult to implement because the design work was being done by contractors. They felt that the participatory approach would delay project implementation.

The other case of a Village Water Master System was in Jenggawah Hippa in Pekalen Sampean. The Jogotirto was the nickname of Ulu-Ulu Desa there. He was a subordinate of the village chief. In general, the involvement and participation of farmers in Jenggawah HIPPA was similar to that found in Mitra Cai in Cirebon. The water users organization was not so well developed.

The Village Irrigation or Dharmatirta System

The Dharmatirta system of water management was informally introduced in parts of Central Java in 1968, and officially introduced throughout the Province in 1971. Although the laws provide certain common guidelines for the Dharmatirta, the details on organization and responsibilities are left to individual irrigation groups.

The Dharmatirta concept presupposes strong but democratic Village Government with the Village Council as the highest local authority. The concept is based on certain Subak principles as well as on customary law. Critical to its operation is voluntary cooperation, mutual help and agreement.

Dharmatirta leaders are usually farmers elected by their constituent farmer members, and are responsible for O&M, as well as for regulation, enforcement and fee collection.

The Glonggong Dharmatirta originated with the local community in 1953. The village's earlier special Irrigation Regulation had governed water distribution quite well. It was based on the village as a unit. All the landowners and tillers in the village belonged to the Dharmatirta. Today, the association membership consists of 85 percent landowners and 15 percent tillers, where 89 percent of owner-cultivators are small farmers (less than 0.5 ha).

The Dharmatirta Chief is the energetic elementary school teacher. The leaders of the Dharmatirta are not necessarily village officials; they can be farmers elected by the farmers of the Dharmatirta directly for three-year periods. The duties of Dharmatirta members are to maintain farm ditches along their own farms and to work together to maintain tertiary canals. In the Glonggong village, farms are grouped into two blocks and each block, in turn, has three sub-sectors.

The Ulu-Ulu, Ulu-Ulu Assistant and 22 Water Guards are responsible for distributing water to each block and to each group. Glonggong Dharmatirta is well developed as a village organization. Its chief is a well-motivated and active leader. From the beginning, the organization was characterized by relatively egalitarian land ownership and a strong tradition of collective work; both leaders and members participated in the planning, design and construction of their irrigation system, from the weir, canals and structures up to farm level. The design process was assisted by the Irrigation Service, but the O&M of the irrigation system is completely the responsibility of Dharmatirta. Only the operation of the weir is supervised by the Public Works.

The Tertiary Level Water Management System

There are significant differences between the Ulu-Ulu Vak (Tertiary Water

Master) and the Ulu-Ulu Desa (Village Water Master). The Ulu-Ulu Vak has responsibility for one tertiary unit, which may cover more than one village, while the Ulu-Ulu Desa has jurisdiction over irrigation in a single village. The former is elected by all the farmers within the boundaries of a tertiary unit, while the latter is selected by the Village Chief. However, both kinds of water masters are compensated in kind or by being given the rights to cultivate communal land.

The Tirto Mulyo Dharmatirta was established on 2 December 1970 as part of the rehabilitation and development programme of tertiary systems financed by the Government. During the rehabilitation of Tirto Mulyo, planning and design were done by a consultant. The consultant had tried to include farmer participation in the design process, through meetings with the Village Chief, Ulu-Ulu Vak, Ulu-Ulu Desa, Dharmatirta Chief and its Committee, and other key farmers. The Schedule of construction implementation was also discussed, so that farmers' needs regarding equitable and efficient water distribution, cropping schedules, and the minimization of the losses of farmers' land (used for new canal development) could be incorporated in the planning and design of the tertiary. Unfortunately, during construction, the contractors did not use local labour fully and there was no collective work effort to complete the project.

Due to the poor motivation of the farmers in the tertiary, a Dharmatirta Committee was again organized in 1975 and, again, in 1977. The Committee was composed of two chiefs, two secretaries, one treasurer and six sector chiefs. The goals of the committee were to provide and regulate irrigation water in an equitable manner. Committee members received compensation. During the general meetings of the association, which were held once a year, committee members were elected and were required to serve for a period of three years. The committee was empowered to plan for and to manage the operation of the system. They could impose fines or sanctions on members who disobeyed rules or regulations. In addition, the activities of the association were supervised by Irrigation and Agriculture officials. Finally, the farmers in the tertiary were also involved in other rural organizations such as the village cooperative and rice production organizations.

2.2 Strategy to Involve Farmers

During the Repelita I (the first five-year national plan which began in 1969), the rehabilitation of existing irrigation systems was initiated with foreign assistance from such institutions as the Asian Development Bank and the World Bank. The targets were ambitious and there were pressures for rapid results and timely implementation. Because of these pressures, a number of procedures in project development was changed. The design of the project, which used to be the responsibility of the Irrigation Service, was contracted to private designers. The tertiary rehabilitation, which had been accomplished by community efforts, was also contracted to private construction firms.

Although the thrust in these years was to increase the responsibility and involvement of government in irrigation development, the application of the policies varied according to the situation in each project area. In Medewi, the planning and design of the rehabilitation were done jointly by the Irrigation Service and the Subak members. As a result, local concerns were addressed. For example, the schedule of construction was planned in view of the planting schedules and the cropping pattern. The Subak was also informed about the design, operating procedures, and special facilities of the system. Training was provided on the operation and maintenance of the physical structures. The government built the major weir; the improvements in the tertiary structures and other facilities were left to the farmers. However, the government still provided supervision and subsidies to the farmers, as required.

In the Glonggong Village Irrigation System, everything was left to the farmers. Government provided guidance, extension and some subsidies. Key farmers and Dharmatirta leaders also received training and incentives. Government construction work was limited to the main and secondary systems - the rehabilitation of the Winong weir, 5 kilometres of main and secondary canals, and 11 diversion boxes. Prior to the rehabilitation work, the association was already functioning well; they had, in fact, constructed during 1977-80 a large number of structures - 53 diversion boxes, 13 Cipolettis, 278 Thompson measuring devices, 23 culverts, 16.68 km of tertiary canals, 10.405 km of quarternary canals, 4.895 km of tertiary drainage canals, 10.05 km of quarternary drainage canals, as well as 91 ha of land levelling.

In Beberan Serang and in Tirto Mulyo, the government also performed the rehabilitation and development work on the tertiary system. Farmers' parti-

cipation was monitored through the regular reports from the Irrigation Committee, from the project management from the contractors and from the designers. External agencies such as the local government, Agriculture Service and Agrarian Service also monitor such activities as the rehabilitation programme, system O&M, water deliveries and collective work.

The support for farmers' participation is found in a number of laws and regulations, such as the Government Regulation, the Presidential Decree, and the Governor's Decree about water users associations. The rationale behind the support for farmers' participation is that, ultimately, farmers have to be responsible for the O&M of their systems and that government may not be able to help each system more than once.

2.3 Linkages with Government Agencies

In village irrigation systems and in tertiaries of large systems, the Agriculture Department is responsible for providing extension and technical assistance. This may also include assistance in water management. Together with the Irrigation Service and the local government, the Agriculture Service seeks to promote water users associations.

In the Jenggawah HIPPA and in Beberan Serang, the Agriculture Service and the local government participate in the Irrigation Committee and provide assistance in the development of the water distribution system, the land-use plan and the cropping calendar.

In the Medewi Subak, the Agriculture Service through its field extension workers conducts training and visit activities twice a week. The Irrigation Service also conducts regular meetings with farmers. In addition, the Agriculture Service, the Irrigation Service, and the local government provide trainers who conduct seminars for key farmers and village chiefs on water management. These agencies also support farmers' initiatives by providing such inputs as construction materials for Subak activities to rehabilitate or improve the irrigation facilities.

3. ASSESSMENT OF SYSTEM PERFORMANCE

In this section, the performance of the various irrigation systems described above is evaluated. The evaluation focuses on three aspects: water distribution, water management and agricultural productivity.

In general, the farmers in community-managed irrigation systems, such as the Subak and Dharmatirta Village Irrigation Systems, have achieved high levels of performance and efficiency in water distribution. This can be attributed to the fact that the farmers in these systems were directly involved in planning, designing, constructing and operating their own systems. The government programmes which brought new technology and engineering improvements permitted these systems to become even more efficient.

3.1 Medewi Subak

The Medewi Subak irrigation area is divided into seven Tempek (blocks) with each Tempek ranging from 3.5 ha up to 79.24 ha. Within the individual block, water is distributed in proportion to the sawah area, using mostly the "Tenah" and the "tek-tek" as measuring units. The tenah is a variable unit of land (about 0.35 ha) which is related to water, land quantity, rice seedling and yield. It also determines the work required of every farmer for irrigation system maintenance. A tek-tek of water, on average, irrigates 0.6 to 0.8 ha of land. The quantity of water from the Medewi river is sufficient for Medewi. Because the weir and the canal of the neighbouring Subak was broken, the water from Medewi weir also irrigates the Yeh Satang Subak, and during the dry season there is a rotation system for the two Subaks.

In the past, the efficiency of water use was relatively low and each sawah was provided with more than enough water. As a result of the training programme on water management, the water use for each sawah improved. The maximum water depth in sawah is now kept at 2.5 cm with a combination of intermittent and continuous irrigation. The Irrigation Service also manages water in the river and water allocation among Subaks. On a regular basis, the Irrigation Service, the Agriculture Service, the Local Government and the Subak formulate the water allocation for each season. Although there is intervention from government, the Medewi Subak is still kept intact as a water management organization. The Medewi Subak still has responsibility for planning improvements and O&M for the whole irrigation system, except for the weir and the allocation of water distribution from the river which are managed by the Public Works.

The financial resources for Medewi are

also managed properly. The sources of funds are as follows:

Members contribution	76 percent
Fines	10 percent
Crop & agric. inputs sales	7 percent
Others	7 percent
Total	100 percent

The members' fee can be classified into several types:

i. A periodical fee which is usually collected after harvest. There are three types of periodical fees:

   a. "Pengat" or "pengampil". Members who are not active participants in Subak activities should pay Rp. 1000/ha. Members who are active participants in each Subak activity pay only Rp. 500/ha. This fee is used for religious ceremonies or for the compensation of the Subak Committees.

   b. "Sarin tahun". Each Subak member pays this fee in kind after each harvest. The amount is set during the Subak members' meeting; in 1982 they paid Rp. 440/ha.

   c. Fee for compensation of Committee Members, which is paid by each member: Rp. 880/7.5 ha or Rp. 117/ha.

ii. A non-periodical fee which is collected on an irregular basis, depending on emergency needs and urgent Subak work (for example, irrigation rehabilitation and improvement).

All funds are spent mainly for the O&M of the system, for religious offerings, for Subak Committee salaries, and for the reserve fund. In 1982, for example, the composition of fund allocation and spending was:

- religious offerings	62 percent
- O&M irrigation system	25 percent
- Subak staff salaries	3 percent
- others	10 percent

Improved water management and agriculture management (due to training on agricultural practices, agricultural inputs, water management, and improvement and rehabilitation of the weir, tunnels and other structures), had several results:

- The cropping pattern and cropping intensity changed significantly. Before improvement, the cropping pattern was paddy-paddy (sometimes with palawija for the third crop). After improvement, the pattern became paddy (100%) - paddy (100%) - palawija (100%). The farmers now use a high yielding variety of paddy with a shorter period of maturity and less water requirement than before. The other positive outcome is the absence of fallow land after the second paddy crop is harvested. Previously, about 60 percent of the land was uncultivated for 65 days.

- Increased paddy production from an average of 3.78 tonnes/ha to an average of 8.0 tonnes/ha. The results of trials on water requirement show that:

  . with a water depth of 2.5 cm, the production became 7.8-8.8 tonnes of paddy/ha;

  . with a water depth in sawah plot of 7.5 cm, the yield was 3.54-4.21 tonnes of paddy/ha.

- Increased farmers' income from Rp. 430 000 to Rp. 580 000 per year per ha due to increased cropping intensity and the change in cropping pattern.

- The elimination of problems of unpaid credit.

- Increases in Subak funds and in Ipeda (land tax) income. Each farmer can now pay for the Ipeda. The farmers' participation in collective work also increased and Subak income from fines decreased.

- The relationship and the coordination between Medewi Subak and Yeh Satang Subak and Puluhan Subak, all receiving water from the same river, improved, particularly in the areas of water distribution and water management. Conflicts among them were successfully reduced.

3.2 Village Irrigation System (Glonggong Dharmatirta)

With the assistance of the Agriculture Service and Irrigation Service, the village chief made a proposal to reorganize the Dharmatirta and to mobilize all resources in the village to develop the Glonggong Dharmatirta, both technically and managerially.

The irrigated area of Glonggong is divided into two blocks with the areas of 138.94 ha and 148.11 ha. Each block is further divided into three groups:

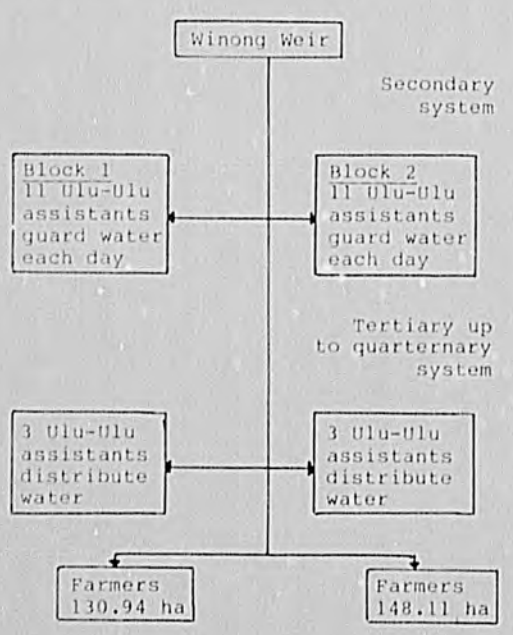
Block I :	Group A :	45.0	ha
	B :	43.3	ha
	C :	56.64	ha
Block II:	Group A :	79.41	ha
	B :	43.0	ha
	C :	25.7	ha

Since 1921, the rotation system between the three villages that get water from Winong weir has been as follows:

- 43 hours for Tunggul Village
- 48 hours for Glonggong Village
- 24 hours for Gondang Village.

In Glonggong village only, the rotation system is divided into two rotations: block 1 for 24 hours, and block 2 for the other 24 hours. Each sawah plot therefore receives irrigation water once (24 hours) in five days. If necessary, particularly during the dry season when water is critical, a rotation system within blocks is also implemented.

In order to have full participation from members and to have water distribution implemented equally and on time, the Ulu-Ulu and the 14 Ulu-Ulu assistants supervise and guard the water distribution. The night before the rotation for Glonggong Village, the Ulu-Ulu inspects the water condition in Winong weir. If water is in short supply, the duty of an assistant can last for 24 hours. The Ulu-Ulu assistant distributes and inspects water from the sub-tertiary and quarternary canals up to the farmers' sawah. He uses a small bamboo as a water measuring device. Each farmer inspects the water distribution from the fifth canal to his sawah. The Ulu-Ulu and his assistants also guard the water distribution among the three villages. The three Ulu-Ulu assistants guard water in their respective areas of responsibility and 11 assistants guard water from the weir to Glonggong Village and up to the subtertiary system.



System maintenance is also well implemented. Every two months the maintenance schedule begins. The Ulu-Ulu, his assistants, and the Dharmatirta Committee plan and control the maintenance activities.

In addition to the labour that farmers provide for system maintenance, farmers also make certain types of contributions in kind to the association. These are:

- fixed contributions (used for O&M):
  - membership fee: 15 kg paddy/ha/season
  - compulsory fee: 60-150 kg paddy/season
  - 60 kg grain paddy during wet season; 90 kg during dry season 1; 150 kg during dry season 2.
- Temporary fund: particularly used for major rehabilitation and improvement of the irrigation system.

The collected fund increased by 44 percent from 1976 to 1980 (from Rp. 1 342 000 in 1976 to Rp. 3 110 000 in 1980). Fewer fines were imposed or collected due to the reduction in violations of rules or delinquencies.

The results of improved water management and improved farmers' participation are reflected in increases in cropping intensity and agricultural production. During the four years after the improvements were made (1976-1980), total area planted increased by 22.8 percent (paddy area increased by 99 percent, but areas in secondary crops decreased by 79 percent, and sugarcane increased by 12 percent), fallow land decreased by 94 percent, and rice production increased by 127 percent (dry season rice production increased by 168 percent). The farmers also accomplished substantial land levelling (91 ha) and soil water conservation, through collective work and full farmers' participation.

3.3 Village Water Master

As a result of improved government implementation procedures for tertiary

development, pilot schemes for operation and maintenance, and food crop intensification programmes, positive changes have occurred in Mitra Cai and HIPPA. The changes have been most visible in the areas of water distribution, operation and maintenance, and food crop production.

The water distribution in Beberan-Serang is regulated according to the demand from three villages and the supply of regulated irrigation water in Situpatok reservoir. The total irrigation water supply is computed from the time series data on the water discharge in the Jamblang river, Luwung river, and the Situpatok reservoir, to make a projected cropping pattern and cropping intensity in the total irrigated agricultural area of Situpatok region and Jamblang region. The total aggregated demand is computed from the summation of individual demand from Beberan Serang recorded each 14 days.

The rotation system with a two-week cycle is applied between tertiary areas. During the dry season there is also a rotation system within the tertiaries. The cropping schedule and cropping rotation are also applied (between paddy-sagarcane-secondary crops). There is a quarterly meeting between the water masters in Mitra Cai and Pengamat Pengairan. A meeting between the Extension Worker (PPL) and each farmers' group is conducted once every two weeks. As such, Mitra Cai Beberan-Serang farmers are involved directly in water distribution from the tertiary outlets. The chief of each group, which consists of 10-15 people (six in Beberan Serang), regulates O&M work in each group.

The Beberan Serang farmers have constructed their own sub-tertiary irrigation system for each village. The Mayor Cai regulates water distribution for each block. The impact of larger farmer involvement and participation in water distribution is that water allocation is based on "crop demand" and not on farmers' "demand". Water is now equitably distributed among the tail, middle and the head portions. Likewise, the condition of canals, drains and structures in the tertiary system have improved. However, the siltation problem (from the main system) still adversely affects the water supply at the tertiary level. This explains why the Mitra Cai farmers regularly dig the silt from the canals.

The system of collecting irrigation water fees in Mitra Cai and Hippa has been working well. Each member contributes 15 kg gabah kering (dry grain) per ha each year and an additional 15 kg is collected from farmers who receive rotation water to grow rice during the dry season. For sugarcane, farmers pay 60 kg per ha per year. The fund is allocated as follows: O&M (45 percent); committee (30 percent); administration (10 percent); and others (including savings) 15 percent. The fund is also augmented from fines. Each farmer who takes water directly from the tertiary canal without the approval from the committee pays a fine of Rp. 1000 in cash. If water is used for other purposes than for crops, the farmer should also pay Rp. 1000.

Due to water management improvements and farmers' participation in water management and agricultural activities, agricultural production has remarkably improved as shown in Table 3.

Table 3 IMPROVEMENTS MADE IN ULU-ULU DESA SCHEMES

	Before improvement		After improvement*	
	Mitra Cai Beberan-Serang	Hippa	Mitra Cai	Hippa
Cropping pattern	Paddy-Paddy	Paddy-Paddy	Paddy-Paddy-Palawija or Paddy-Palawija-Palawija	Paddy-Paddy-Palawija
Cropping intensity	200%	200%	225%	225%
Average paddy yield/ ha (tonnes)	3.88	3.5	5.14	6.2
Paddy yield under Bimas (tonnes)	4.92	3.6 ton/ha	6.71	6.8 tonnes/ha
Inmas (tonnes)	3.13	3.4 ton/ha	4.54	5.9 tonnes/ha
Paddy yield (tonnes grain paddy ha)				
- at the head end	4.96	3.9	6.89	7.0 tonnes/ha
- at the middle end	3.87	3.7	6.78	6.8 tonnes/ha
- at the tail end	3.52	3.4	4.91	6.6 tonnes/ha

* Due to improved water management and agricultural management.

3.4 Tertiary Water Master Scheme in Tirto Mulyo Dharmatirta

The results of increased farmers' involvement in system development and management are reflected in the condition of the physical facilities, water distribution, agricultural production, farmers' income, and irrigation management system.

The physical condition of the tertiary irrigation system in Tirto Mulyo Dharmatirta has changed as a result of the larger farmers becoming involved in collective work, and the support of the government. Through farmers' self-help activities, the sub-tertiary canal (1.5 km), 3 culverts and 0.5 km of quarternary canal were developed. In 1978, tertiary, sub-tertiary and quarternary canals were also rehabilitated as well as 7 division boxes, 6 culverts and other structures.

Through the improvement of irrigation facilities, water distribution in the system has improved. Rotation is applied among tertiary sectors of the Gung Irrigation System of which Tirto Mulyo is a part. Based on water demand and water supply, there are six rotation areas in the Gung Irrigation System. Beginning in 1978, the quarternary canal rotation was implemented. Constant fixed rotation was no longer applied. The planting of sugarcane was also rotated among blocks on a group system. These changes resulted in a more equitable distribution of water.

The operation and maintenance of the scheme was also improved. The Ulu-Ulu-Vak, two Ulu-Ulu Desas, the chiefs of irrigation block, and the chiefs of the farmers' irrigation group regulate and operate the system. The maintenance is worked out by them in consultation with all the farmers in each group.

The Tirto Mulyo revenue comes from the membership fees, penalty-fee/fines, other members' fees, and other resources (subsidy and aids from government). The membership fee is 60 kg in the form of grain paddy per ha per year. The revenue funds are used for the Dharmatirta Committee, for O&M, and for savings.

Due to better delivery of agricultural extension, agricultural inputs and improved water management agricultural production has also increased.

The harvested area and production has increased by 11 percent and 39 percent respectively. The cropping intensity increased by 16 percent, and the cropping pattern has shifted to higher value commercial crops (such as red pepper, onion, and soybean).

	Before improvement (before 1976)	After improvement*
- Paddy yield (tonnes of paddy/ha)	3.6	5.0
- Farmers' income (Rupiah)	178 352	282 924

* Due to improved water management and agricultural management.

4. EVALUATION

As mentioned in the previous section, the Government continues to accord high priority to irrigation development in order to increase farmers' income. Several studies and seminars have recognized that the proper operation and maintenance of irrigation facilities is largely dependent on farmers' participation and involvement in the irrigation development process. Results from the studies of Medewi, Glonggong and Tirto Mulyo, Beberan Serang and Jenggawah reveal the benefits of larger involvement of farmers in system development, operation and maintenance.

4.1 Contributory Factors

The main factors which contributed to greater farmer involvement in irrigation system management are as follows:

Technical factors

i. Government assistance and support in terms of the design of main structures and in terms of construction materials (for instance cement and bricks), and technical supervision served as incentives for farmer participation. In Medewi, the government rehabilitated the weir. In Glonggong, cement and bricks were provided to the farmers which permitted them to develop physical structures and irrigation canals.

ii. Agricultural and water management extension through the Training and Visit system proved to be the best method for motivating the farmers to participate in system operation. The establishment of competitions among farmer groups for water management, and the training and visit system, encouraged farmers to develop their

organizations and their management skills.

iii. Agriculture inputs (water, fertilizers, pesticides, credits, agricultural equipment and construction materials) were available to farmers at any time, at the right amount, at the right place, at a good quality, and at a reasonable price.

iv. The facilities which were designed and constructed under the supervision of the government were simple, strong, and relatively inexpensive for farmers to operate.

Socio-economic factors

i. The integration of the local organization in the new Water Users Association (WUA) minimized conflicts, for instance, in Mitra Cai, where the chief of the association is also the Raksabumi, and where the Mayor Cai is also a Water Master.

ii. The integration of the Ipeda tax (land tax) with the WUA's fee simplified financial procedures.

iii. Collective work was scheduled during farmers' leisure time, and did not interfere with their productive time.

iv. Good linkages existed between the members of the Irrigation Committee, particularly among the Engineers and the farmers. Good linkages were also maintained among the government officials who were in charge of water management.

v. Penalties and sanctions were also applied in implementing water management policies and regulations.

Institutional factors

i. Government intervention did not encroach on Subak management and responsibilities. The government had responsibility only up to the level of the weir and did not take part in the Subak management of the main system. The water management at farm level was also left to the farmers.

ii. The local farmers' organization and the WUA were integrated.

iii. The WUA representative was a member of the Irrigation Committee at the Sub-district (Kecamatan) level.

4.2 Constraints

The general and specific factors which constrain the involvement of farmers in system operation and management can be classified as follows:

Technical factors

i. Due to the pressure to meet targets for the development of irrigation systems (2 million ha for Repelita III), there is a tendency to limit the farmers' participation in the development process (planning design, and construction). For instance, in Jenggawah, Beberan Serang and Tirto Mulyo, there were few activities (in design and construction) which made use of farmers' participation.

Farmers' participation in the development process may require more time which may delay completion of physical targets.

This concern has also influenced consultants and contractors (who are mostly concerned with profits and with efficiency) to avoid farmers' participation.

ii. The irrigation systems (especially the tertiary irrigation facilities) developed by the government have been poorly constructed and inappropriately located; as a result, the facilities are often not functional. In Tirto Mulyo, the tertiary structures were misplaced and actually impeded the water distribution.

Socio-economic factors

i. The WUA fee collected from its members, if combined with Ipeda and other indirect taxes, burden farmers.

ii. Government agency staff usually have limited knowledge of farmers' needs and aspirations, and a lack of training on water management.

iii. The generally poor conditions of roads and of the communication system in the location of the WUA hinder the development process and the marketing of agriculture products.

Institutional factors

i. The WUAs have been established using a top/down approach without considering farmers' needs and aspirations. The local small

farmers' organizations were not involved in the development process. They were just spectators, instead of participants.

The Irrigation Committee usually exists only on paper but not in practice. The linkages among agencies concerned with water management are deficient. Likewise, there are few linkages between farmers and the agencies concerned.

ii. The WUA cannot act as a private contractor to implement the construction of tertiary development due to Presidential Decree No. 14A/1980.

4.3 Lessons Learned

The most important lessons learned from the case studies have been identified as follows:

a. In the planning process of establishing the WUA, the principle of bottom/up planning is important in order to gain the farmers' confidence and interest and to integrate the existing local organization into the new WUA. The government should not rush to build a WUA at each village tertiary unit. During the tertiary rehabilitation process, the WUA will grow and develop by itself. The problem is how to meet specific government requirements and those of the farmers.

b. The government should retain the farmers' responsibility for irrigation management, particularly in community-operated systems. On the other hand, some government intervention and assistance should be provided. For the Subak system and village (traditional) irrigation systems, the management of the system should remain the responsibility of the farmers. If the government has assisted in the rehabilitation of the weir and other larger structures, the operation and maintenance of the system should not be taken over by the government.

c. The established practice of farmers' participation in maintenance and repair work should be strengthened, not abolished. To obtain larger farmers' participation, a government subsidy or incentive may bring added benefits. Farmers' participation should be secured from the beginning in planning, design, construction and O&M.

d. An integrated approach in providing agricultural inputs, improved water management and better farmers' participation will result in greater agricultural production and in increased farmers' income.

ANALYSIS OF TECHNICAL CONSTRAINTS INFLUENCING FARMERS' PARTICIPATION IN WATER MANAGEMENT AT THE TERTIARY LEVEL

by

Suprodjo Pusposutardjo, Harsono and
Muchjidin Mawardi[1]

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1. INTRODUCTION

The Indonesian archipelago is situated within the tropical monsoon region. The annual rainfall varies from 1500 to 3000 mm, with a distinct difference between the wet and the dry seasons. Generally the annual rainfall shows few seasonal variations, but the monthly rainfall is strongly affected by the amount and timing of the rainy season. Very often these variations cause crop failures and threaten economic stability.

The Government of Indonesia, in an attempt to overcome water shortages and problems in crop production, has placed high priority on irrigation development in the Five-Year Development Programme (Pelita). The irrigation development work which was completed up to Pelita II is listed in Table 1. By October 1977, the total irrigated area (including swamp and tidal irrigation systems) reached 5.03 million ha. The irrigation development programme in Indonesia is still continuing with a slight change in its aims. Since Pelita III (1979/1980 - 1983/84), the programmes have been emphasizing tertiary development and the improvement of water management, besides the continuing rehabilitation programme and the construction of new systems.

Table 1 IRRIGATION DEVELOPMENT UNDER PELITA I AND PELITA II

Type of Programme	Pelita I (ha) (1969/70-1973/74)	Pelita II (ha)[1] (1974/75-1978/79)	Total (ha)
Irrigation rehabilitation	953 546	326 110	1 279 656
Irrigation extension	191 246	172 641	363 887
River and flood control	248 585	299 897	598 482
Swamp and tidal development	33 078	—[2]	33 078
Total	1 426 455	798 648	2 225 103

[1] Includes only area developed up to 30 June 1977.

[2] For Pelita II the areas for swamp land development are included under "River and flood control".

Source: Directorate General of Water Resources Development.

The irrigation development programmes encountered many technical, social and economic problems, and some of them proved unsuccessful.[1] Water management problems mostly occur in Java, where 64 percent of the irrigated areas are located, although the total area of this island is only 5 percent of the total area of the country, and the population almost 50 percent of that of the whole country.

The irrigated areas can be classified into three groups according to the water management facilities provided: technical, semi-technical and non-technical.

Technical irrigation systems have permanent structures, and the volumes of incoming and distributed water are fully controlled and measured at a number of points in the system. Normally the water supply system is separated from the drainage system. The semi-technical irrigation systems are provided with few water controls or measuring devices, which may be permanent or semi-permanent.

In a non-technical irrigation system the volumes of incoming and distributed water are not controlled and measurable. Irrigation schemes developed by the Government are mostly technical. Only a few of them are semi-technical.

The management of the main system in a technical or semi-technical irrigation scheme is the responsibility of the government and is separated from the management of the tertiary system where the farmers are responsible for management. To some extent, the government gives advice to the farmers, especially on technical aspects. Obviously the success of water management at the tertiary level largely depends upon participation of farmers.

This paper analyses several factors

[1] Economic and Social Commission for Asia and the Pacific, Proceedings of the Symposium on Social and Non-economic Factors in Water Resources Development. Water Resources Series No. 47, United Nations, New York. 1975. pp. 104-107.

which are considered to be constraints to farmer participation in water management at the tertiary level. The analyses are based on data collected during a field survey in the Pekalen-Sampean Irrigation Schemes (PSIS), which was conducted from the fourth week of December 1983 until the third week of January 1984. Additional data were also collected from the Setupatok Irrigation Scheme (SIS) and the Losari Irrigation Scheme (LIS). These data were collected from an earlier study at the SIS in 1982 and the partially-completed study of the LIS where research activities are still going on. The three sample studies are representative of the existing water management situation in most irrigated areas in Indonesia.

2. DESCRIPTION OF STUDY AREAS

2.1 The Pekelen-Sampean Irrigation Scheme (PSIS)

2.1.1 General

This scheme is one of Indonesia's oldest and largest irrigation schemes (see Fig. 1). Its first infrastructure was constructed as early as 1781 to provide irrigation for sugarcane.[1] The present command area of the scheme is approximately 280 000 ha.

Administratively, the PSIS consists of three regions (wilayah), each divided into several sections and subsections. The two subsections of Situbondo and Panarukan (in Situbondo section) were selected as sample study areas as they are representative of the conditions of the whole scheme. Data concerning the technical aspects of the scheme were collected from three secondary canals representing the head, middle and tail. The physical features of each secondary canal were represented by the condition of three selected tertiary blocks taken respectively from the head, middle and tail. In each tertiary block, ten farmers and three farmers' groups were interviewed concerning their participation in the planning, design and management of the irrigation system.

The Situbondo irrigation section is situated 180 km east of Surabya. The altitude of the command area ranges from 0 to 72 m above sea level.

2.1.2 Climate

The Situbondo and Panarukan subsections have four consecutive wet months from December to March and the remainder are considered dry. Climatic data are shown in Table 2 for Waringin Anom, within the PSIS.

Table 2 CLIMATIC DATA AT WARINGIN ANOM, JAWA TIMUR (EAST JAVA) (1977-83)

Month	Temp. °C	Relative Humidity (%)	Percentage of sunshine	Pan Evaporation (mm/day)	Rainfall (mm)
September	27.9	76.5	83.2	8	3
October	28.5	76.7	79.9	9	22
November	28.6	77.0	71.8	8	87
December	27.5	82.0	54.1	6	212
January	27.2	84.9	51.4	5	418
February	27.1	84.8	53.9	5	277
March	27.4	82.7	63.6	6	246
April	28.0	84.0	67.7	6	58
May	27.9	79.8	72.8	6	78
June	27.7	78.6	52.0	6	50
July	27.6	77.2	80.3	7	11
August	27.5	76.4	80.5	8	7

2.1.3 Soils and water quality

Soils in the study area are Entisols (FAO classification: Regosols). Soil samples were taken to determine their physical properties. Results of the laboratory analyses are presented in Table 3. The soil texture between the head and tail of the secondary canal is slightly different, with a lighter texture closer to the coast. There is no significant difference in soil pH among the samples, the range varying from 7.5 to 7.8. This pH is suitable

[1] Taylor D.C. Financing irrigation services in the Pekelen-Sampean Irrigation Project, East Java. In: Irrigation Policy and the Management of Irrigation Systems in Southeast. D.C. Taylor and T.H. Wickham (eds.). The Agricultural Development Council Inc., Bangkok. 1976. pp. 111-122.

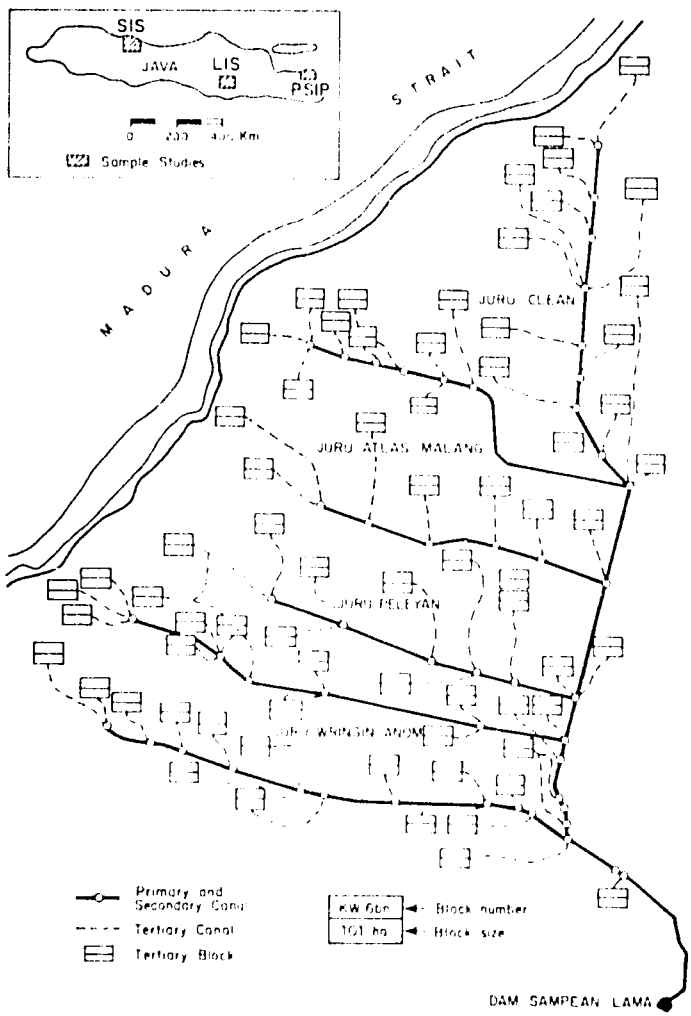

Fig. 1 Situbondo Subdivision Irrigation Scheme of the PSIP

Table 3 PHYSICAL CHARACTERISTICS OF THE IRRIGATED SOIL IN SITUBONDO DISTRICT

Location	Texture	Colour	pH	Consistency
KD_1	Sandy clay	5 $YR^{2.5/2}$	7.5	Sticky
KD_4	Sandy clay	5 $YR^{2.5/2}$	7.7	Sticky
KD_6	Sandy clay	5 $YR^{2.5/2}$	7.8	Sticky
KW_3	Silty clay	5 $YR^{2.5/2}$	7.6	Sticky
KW_6	Silty clay	5 $YR^{2.5/2}$	7.7	Sticky
KW_7	Silty clay	5 $YR^{2.5/2}$	7.5	Sticky

for rice, palawija* and sugarcane.

Samples of irrigation water were also taken from the head and tail of the secondary canal. On analysis, these water samples indicate that neither their physical nor chemical properties are harmful to most crops or soil (Table 4).

Table 4 WATER QUALITY OF THE FIRST SITUBONDO MAIN CANAL

Location	Ca meq/l	Mg meq/l	Na meq/l	SAR	pH	ppm
KD_1	30	4.6	3.90	2.33	7.3	224
KW_7	50	4.6	3.51	1.86	7.5	272

2.1.4 Cropping pattern and agronomic practices

The existing cropping pattern in the command area of Situbondo section can be classified as follows:

- continuous rice
- two consecutive rice crops followed by palawija
- one rice crop followed by sugarcane. If conditions permit, palawija crops are grown after the sugarcane harvest.

Continuous rice cropping is normally not recommended as it may create problems of pest control, water shortage during the dry season and difficulties in maintenance of the irrigation structures. Despite the high risk, however, most farmers prefer to grow rice continuously to obtain a good yield of their third rice crop.

Palawija crops are usually maize or soybean, maize being the most common. The existing cropping pattern is presented in Figure 2.

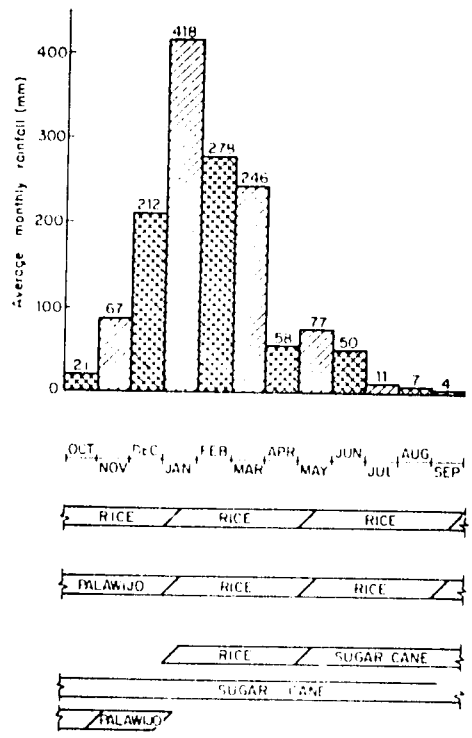

Fig. 2 General cropping pattern in the command area of Situbondo Irrigation Section

Agricultural practices in the irrigation scheme are very intensive. Farmers grow high-yielding varieties of both rice and palawija. The normal

* Food crops grown during the dry season in the rice field such as maize, groundnut, soybean, small green bean, cassava.

rate of fertilizer application is between 200 and 250 kg/ha urea and 100 kg/ha triple superphosphate (TSP). Pest and disease controls are undertaken as required. The average yields/ha of rice, maize and soybean are 6.19, 1.5 and 1.0 tonnes, respectively.

2.1.5 Existing physical conditions of the system

i. Water resources: The PSIS is a gravity flow, river diversion system. The Sampean Lama dam diverts water from the Sampean river to the Situbondo Irrigation Scheme through the First West Situbondo main canal. The total catchment area of the dam is approximately 1120 km².

Table 5 shows the average monthly discharges of the Sampean river which fluctuates according to seasonal rainfall changes. The monthly discharge reaches its maximum in February/March and minimum in September/October. However, discharges also appear to be decreasing with time.

Table 5 AVERAGE MONTHLY DISCHARGE OF THE SAMPEAN RIVER AT THE SAMPEAN LAMA DAM (1978-83)

Month	Discharge (l/s)
October	4791
November	5794
December	7148
January	7761
February	8097
March	8147
April	7697
May	7051
June	6687
July	5701
August	5077
September	4912

Source: Public Works Situbondo Irrigation Section

ii. System layout: Figure 1 shows the layout of the First West Situbondo main canal. Three secondary canals, the Waringin Anom, the Alas Malang and the Duwet were selected for sample studies representing the head, middle and tail canals, respectively. Samples of the selected tertiary blocks in each secondary canal are given in Table 6.

iii. Structural conditions: The original irrigation infrastructure of the PSIS deteriorated badly after World War II. A major rehabilitation of the scheme was initiated in the early 1970s with partial support from a World Bank-International Development Association (IDA) Loan. The rehabilitation of the whole Situbondo irrigation system was completed in 1979.

At present the total length of the First West Situbondo main canal is 10 km, with 13 diversions to secondary canals. The delivery capacity of the main canal is 8000 l/s, projected to irrigate 4528 ha of rice fields.

The main structures of the irrigation system up to the diversion structure are: the offtake or turnout, measuring device diversion box, and drop structure. The volume of incoming water into the tertiary block is measured by a Cipoletti device. The structures and the total length of the delivery canal in the study areas are shown in Table 7. The evaluation reveals that most of the canals are damaged, especially the tertiary canals (Table 8).

Moreover, the discharge measuring devices do not work properly. The results from the calibration of six randomly selected measuring devices showed considerable measurement errors (34-163 percent). These may have resulted from discrepancies in the construction of the measuring devices and the incorrect construction of the diversion box in the tertiary block. From 31 samples of diversion boxes, it proved that 42 percent were incorrectly placed, in that their elevations were lower than the irrigated fields or that the downstream box was higher than the upstream box.

iv. Servicing capacity: Because of the decreasing water supply from the river and the poor condition of the structures, the servicing capacity of the system is decreasing. Samples taken from 124 farmers in the scheme showed that 20.2 percent of them were faced with a water shortage for their second rice crop. Even during the wet

Table 6 STRUCTURES IN THE TERTIARY SAMPLES OF THE FIRST WEST SITUBONDO IRRIGATION SYSTEM

Sample study area	Location	Box	Measuring Device	Canal Length (m) Secondary	Tertiary	Quarternary[1]
Waringin Anom	Head	-	1	4616	-	-
- KW_3 tc	Head	3	1	-	570	1650
- KW_6 tc	Middle	2	1	-	2290	2900
- KW_7 tc	Tail	1	1	-	300	700
Alas Malang	Head	-	-	3793	-	-
- KA_1 tc	Head	2	1	-	216.6	-
- KA_3 tc	Middle	2	1	-	275	-
- KA_4 tc	Tail	3	1	-	366.6	-
Duwet	Head	-	-	-	-	-
- KD_1 tc	Head	8	1	-	1714.3	-
- KD_4 tc	Middle	2	-	176.8	-	
- KD_6 tc	Tail	2	-	-	358.7	-

[1] Based on secondary data obtained from the Situbondo Subdivision Irrigation Office.

tc = tertiary canal

Table 7 TOTAL COMMAND AREAS AND CANAL DENSITY OF THE SAMPLE STUDIES IN THE FIRST WEST SITUBONDO IRRIGATION SCHEME

Sample study area	Location	Total command areas (ha)	Canal density (m/ha)
Waringen Anom	Head	582	7.93
- KW_3 tc	Head	39	14.62
- KW_6 tc	Middle	103	22.23
- KW_7 tc	Tail	57	5.26
- KW_3 qc (R)[1]	Head	39	57.69
- KW_6 qc (R)	Middle	103	50.19
- KW_7 qc (R)	Tail	57	17.54
Alas Malang	Middle	531	7.14
- KA_1 tc	Head	36	6.02
- KA_3 tc	Middle	101	2.72
- KA_4 tc	Tail	74	4.95
- KA_1 qc (R)	Head	36	-
- KA_3 qc (R)	Middle	101	-
- KA_4 qc (R)	Tail	74	-
Duwet	Tail	-	-
- KD_1 tc	Head	357.60	4.79
- KD_4 tc	Middle	40.95	4.32
- KD_6 tc	Tail	171.55	2.09
- KD_1 qc (R)	Head	357.60	-
- KD_4 qc (R)	Middle	40.90	-
- KD_6 qc (R)	Tail	171.55	-

[1] qc = quaternary canal

Table 8 DETERIORATED STRUCTURES AND CANALS IN THE SAMPLE STUDY AREA OF THE FIRST WEST SITUBONDO IRRIGATION SYSTEM

Sample study area	Location	Percentage of deteriorated structures: Box Total	Box %	Meas. Dev. Total	Meas. Dev. %	Canal (m) Total	Canal (m) %	Dykes (m) Total	Dykes (m) %
Waringin Anom	Head	-	-	0	0	4616	100	33	0.8
- KW_3 tc	Head	1	33.3	0	0	570	100	446	78.3
- KW_6 tc	Middle	0	0	0	0	2290	100	903	39.4
KW_7 tc	Tail	-	-	-	100	300	100	300	100
Alas Malang	Middle	-	-	-	-	3793	100	267	7
- KA_1 tc	Head	0	0	0	0	217	100	155	71.7
- KA_3 tc	Middle	0	0	0	0	275	100	2	0.7
- KA_4 tc	Tail	1	33.3	0	0	367	100	128	34
Duwet	Tail	-	-	-	-	-	-	-	-
- KD_1 tc	Head	0	0	0	0	1714	100	66	3.8
- KD_4 tc	Middle	1 50	0	0	177	100	130	73.8	
- KD_6 tc	Tail	0	0	0	0	259	100	359	100

Meas. Dev. = measuring device

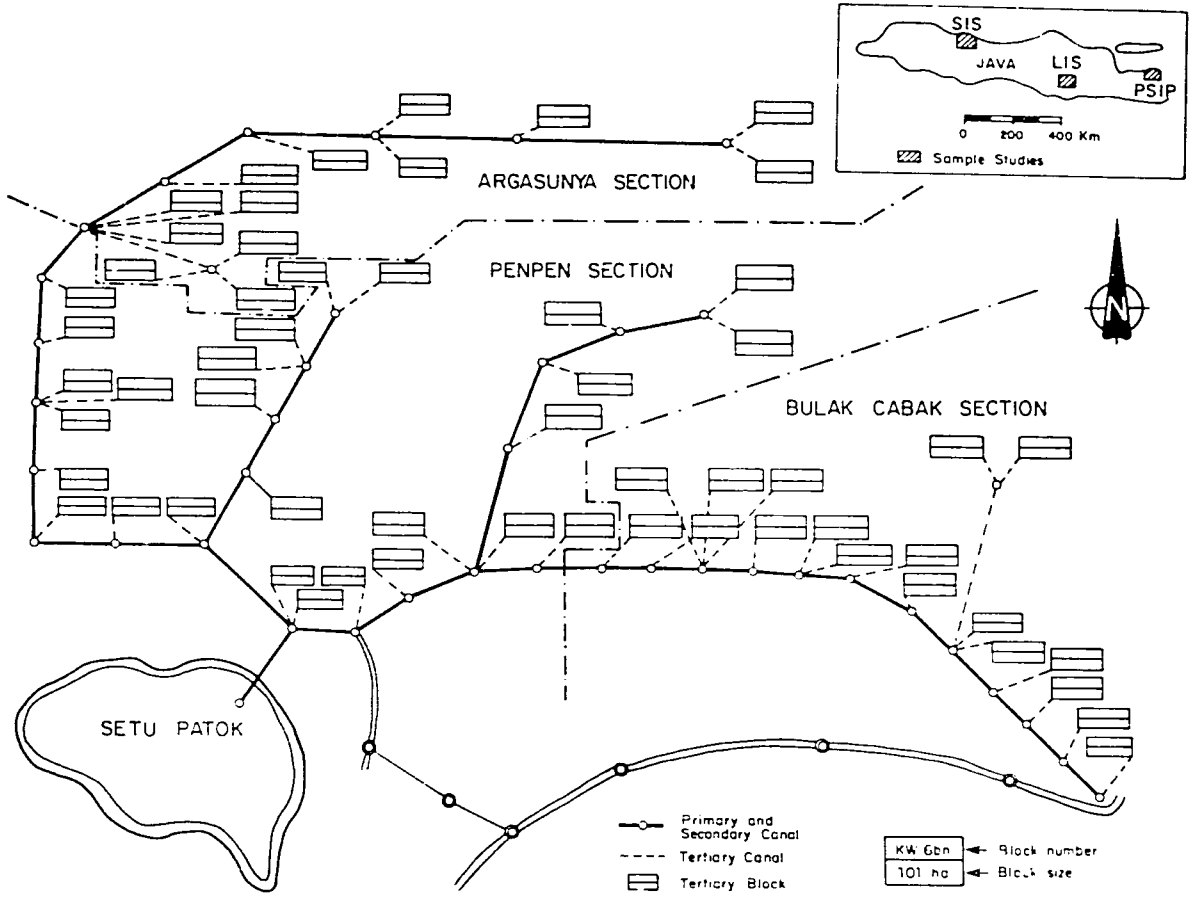

Fig. 3 Setupatok Irrigation Scheme

season, 3.2 percent of the farmers still receive insufficient water.

2.2 The Setupatok Irrigation Scheme (SIS)

2.2.1 General

The SIS is located in Cirebon district, Jawa-Barat (West Java), 6° 40' S and 101° 40' E. The coastal plan in which the area is situated is slightly undulating. The layout of the SIS is shown in Figure 3. The tertiary block LWX was selected for the sample study. This tertiary block covers three villages, Munjul, Gumulung Lebak and Gumulung Tonggoh, with a total command area of 42 ha.

2.2.2 Climate

The SIS area has four consecutive wet months (December-March) and five consecutive dry months (June-October) (Table 9). The monthly rainfall over the wet season varies relatively little from year to year, as compared to those in the dry season. Table 9 shows that the monthly temperature is almost constant throughout the year. The slight fluctuations in relative humidity and percentage of sunshine reflect the differences in the wet and dry seasons.

In general this type of climate is suitable for rice and palawija crops, such as maize, groundnut, soybean, mung beans and sweet potatoes.

Table 9 CLIMATIC DATA AT CILEDUG, JAWA BARAT (1975-80)

Month	Temp. (°C)	Relative humidity (%)	Percentage of sunshine	Pan evaporation[1] (mm/day)	Rainfall (mm)
September	29.3	74	67	7	34
October	32.7	75	67	7	56
November	30.3	78	58	3	172
December	29.2	90	33	5	306
January	24.8	86	34	-	379
February	24.6	86	35	-	331
March	24.3	87	38	1	324
April	25.8	76	44	2	116
May	28.4	63	58	2	113
June	27.7	62	57	5	33
July	28.7	77	67	6	162
August	29.2	73	67	6	146

[1] Data available for 1980 only.

2.2.3 Soils

The soils of the service area of the SIS are dominated by Entisols, Ultisols and their associations. On average the soils have a sandy clay to clay texture, with a weak-blocky structure, are plastic and moderately permeable. The maximum water holding capacity is 82.3 percent of dry weight. The soil moisture content at the plasticity index, field capacity and permanent wilting point are 42.3, 31.2 and 19.9 percent of dry weight, respectively. These physical properties reveal that the water requirements for wetland preparation are high.

2.2.4 Cropping pattern and agronomic practices

The general cropping pattern in the SIS (see Fig. 4) is rice-rice-palawija. Every three years, a crop rotation to rice-sugarcane is applied. The land preparation for wet season rice is usually carried out in April/May. The second rice crop normally does not yield without additional irrigation water.

All crops are grown under intensive agronomic practices. The dosage of fertilizer per ha of rice crop is 200-250 kg urea and 50-100 kg TSP. Pest control is undertaken as required. Under this type of crop management, the average yields/ha for rice, maize, soybean and groundnut are 5.1, 2.2, 0.5 and 1.3 tonnes, respectively.

2.2.5 Existing physical conditions of the system

i. Water resources: The water resources of the SIS come from the Setupatok reservoir and river diversion weirs. The reservoir supplies the weirs

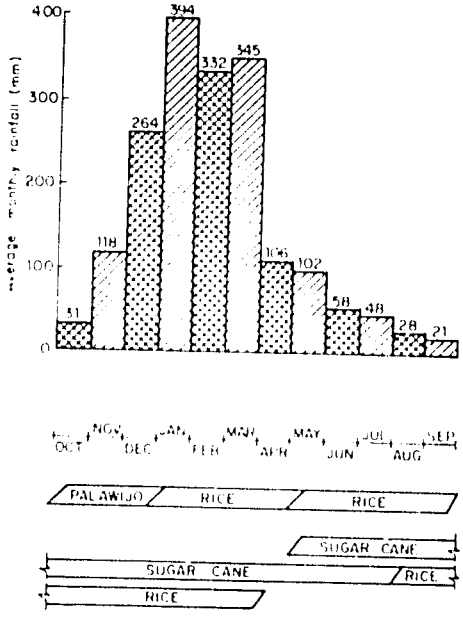

Fig. 4 Cropping patterns in the SIS command area

with the water required for land preparation at the beginning of the rainy season, for all irrigation required during the dry season. The storage capacity of Setupatok reservoir varies from 14.28 x 10^6 m^3 (peak storage) in May to 2.88 x 10^6 m^3 (minimum) in November, with an average of 5.90 x 10^6 m^3. During the rainy season the inflow of the reservoir often exceeds the storage capacity.

ii. System layout: The distribution system of the SIS consists of two main canals, the Argosunya and the Luwung, with a total length of 7150 m. The sample study area of the LW X tertiary canal receives water from the Luwung main canal, diverted through the BLW 10 offtake (Fig. 3).

iii. Structural conditions: The SIS was completely rehabilitated in 1976 from the intake gate up to the tertiary structures. The Luwung main canal is provided with 17 offtake gates, each with a discharge measuring device. Water flows from the offtake gate through the tertiary canal and terminates in a tertiary box. The outlets of the tertiary box are the quaternary canals. In some tertiary systems the structures have deteriorated or are not functioning. It is suspected that this condition is due to improper construction, causing dissatisfaction among farmers. For instance, the second tertiary box of the section is constructed with one outlet lower than the adjacent field. In attempting to make it work, farmers also destroyed another outlet.

iv. Actual supply capacity: By checking 10 offtakes along the Luwung main canal, it was found that water delivered through the tertiary blocks was equal to the irrigation requirement of the planned crops. However, the distribution uniformity inside the tertiary block needed to be improved. The uniformity of water distribution within the LWX tertiary block is shown in Table 10. The common problem in water shortage is usually the result of a greater area put under rice than actually planned for. This problem is very difficult to solve as it is closely related to the socio-economic conditions of the farmers.

Another problem related to the limited servicing capacity of the system, especially for rice, is the difference between the water required by the farmer and the water allocated. Farmers consider the irrigation water should be sufficient to keep their rice fields continuously submerged. The allocated water is sometimes only sufficient to keep a minimal level of water.

Table 10 shows that the servicing capacity of the system to maintain stagnant water and partial submergence is only 60 percent of the design capacity. The water supply to the system decreases slightly during the dry season. Comparing the conditions of the head and tail of the canal, both sections receive equal amounts of water. This means that irrigation water is distributed equally within the tertiary block.

2.3 The Losari Irrigation Scheme (LIS)

2.3.1 General

The LIS is a small irrigation system, with a planned irrigated area of 445

Table 10 AVERAGE WATER DISTRIBUTION WITHIN THE LW X TERTIARY BLOCK IN 1981-82

Location of sample area with respect to the intake	Conditions of the field after irrigation	Area percentage in wet season	Area percentage in dry season
Head	a. stagnant water	20.7	26.1
	b. partially submerged	41.7	31.7
	c. wet	25.5	28.0
	d. moist to dry	12.1	14.2
Tail	a. stagnant water	24.8	29.4
	b. partially submerged	37.6	30.2
	c. wet	17.0	27.4
	d. moist to dry	7.6	13.0

ha. The system is located alongside the Surakarta-Madiun highway, about 80 m above sea level. Administratively, the system is located in Mantingan sub-district (kecamatan), in Jawa Timur (East Java). The topography of the land is classified as flat to gentle.

2.3.2 Climate

Based on the rainfall data observed at Mantingan rainfall station over the past ten years (1970 to 1980), the LIS has more than five consecutive wet months (November-April) and only three dry months. This means that rice can be grown at least twice a year. Minimum and maximum temperatures are 22 and 32°C respectively. Climatic data obtained from Iswahyudi climatological station (located 25 km from the LIS) are given in Table 11.

2.3.3 Soil

The soil of the system is classified as Inceptisol. Formerly this soil was immature, having a weaker profile than mature soils, formed from volcanic material. The bulk density is less than 0.85 g/cm³ and base saturation less than 50 percent at a depth of 2 m. The clay fraction is composed of more than 35 percent montmorillonite, containing less than 40 percent calcium carbonate equivalent with high phosphorus and potassium content. The soil texture is silty clay.

2.3.4 Cropping pattern

Rice is the main crop in the area, especially in the rainy season. Farmers grow rice twice a year, followed by palawija crops such as beans, groundnuts and maize. Rice can be grown three times a year in some parts of the area, especially when close to the main system. Presently, sugarcane is commonly planted as a second crop after rice.

2.3.5 Existing physical conditions of the system

i. Water resources: The main water resource of the LIS is the Losari reservoir, built in 1942, and supplied by the small Losari river. At present the Losari reservoir is no longer functioning, due to siltation of the storage volume. As a consequence the reservoir can supply the

Table 11 CLIMATIC DATA AT ISWAHYUDI, JAWA TIMUR (1971-79)

Month	Temp. °C	Relative humidity (%)	Sunshine (%)	Pan evaporation (mm/day)	Wind velocity (knots)	Rainfall (mm)
September	26.5	67	81	-	15	51
October	27.1	69	73	-	11	143
November	26.8	74	64	-	11	168
December	26.1	80	55	-	8	207
January	25.3	85	45	-	9	277
February	25.3	85	43	-	7	270
March	25.3	85	51	-	8	259
April	26.2	81	73	-	8	336
May	25.9	79	74	-	8	179
June	25.7	73	79	-	11	90
July	25.1	68	86	-	13	24
August	25.9	70	84	-	14	33

irrigation needs for only two months after the rainy season. During the dry season there is no water at all in the reservoir, except for a small flow from the Losari river.

ii. System layout: The system has only one main conveyance canal of 2200 m length. There are eight offtake gates along the main canal, feeding the tertiary canals. The layout of the LIS is shown in Figure 5.

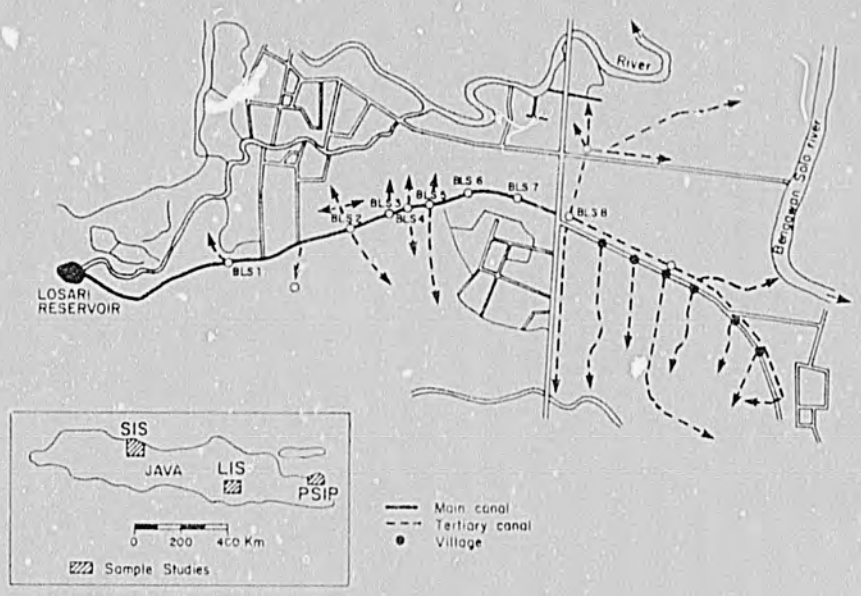

Fig. 5 Losari Irrigation Scheme

iii. Structural conditions: Technically, none of the LIS structures are functioning. The rehabilitation works are still in progress, mainly for the tertiary distribution system. The field survey showed that some structures were improperly constructed. Of 8 offtakes, 3 are installed too high, so that irrigation water from the main has difficulty in flowing to the tertiary canal. Also some offtakes have been improperly designed. For example, the opening of the 8th offtake which is to serve 130 ha is 30 cm wide. Other offtakes (the 4th and 5th) have openings of 80 and 50 cm, although their service areas are only 10 and 5 ha respectively. Some farmers also complain about the incorrect locations of their offtakes. No information can be obtained as to when the last rehabilitation works were carried out because the local farmers have not been involved in the works. From the existing physical condition of the structures, it was estimated that the last rehabilitation was carried out not longer than ten years ago.

iv. Capacity of the servicing area: The servicing capacity of the LIS under normal conditions is much less than expected. Out of the 445 ha of targetted areas, only 60 ha can be fully irrigated for continuous rice, and 150 ha for two consecutive rice crops and one palawija. The remaining areas receive water during the rainy season only. During the dry season, irrigation of rice and palawija crops is also provided by pumping water from shallow wells. These pumps are operated and managed by small groups of farmers without government intervention. The servicing capacity of the LIS decreases, especially beyond the main canal, where the tertiary structures have deteriorated badly.

3. ANALYSIS

Many factors prevent farmers' parti-

cipating in the efficient utilization of irrigation facilities. The following analysis identifies these technical constraints and the linkage between government efforts and farmers' attitudes towards the development and utilization of the irrigation system.

3.1 Technical constraints to the efficient use of the irrigation system influencing farmers' participation

Korten (1981)[1] identified four key limitations of centralized, service-delivery approaches which restrict their benefits to the rural and urban poor and have contributed to the recent interest in the participatory approach: their limited reach; their inability to sustain necessary local level action; their limited adaptability to local circumstances; and their creation of dependency. These factors are used to analyse farmers' participation for the efficient use of irrigation systems with particular focus on the technical constraints. In this analysis, the development of the irrigation system is considered to be one of the service-delivery approaches carried out by the government.

i. Limited reach

In the development of irrigation systems, the Government of Indonesia follows a policy in which planning, design and construction of the tertiary system are conducted initially by the Government. After construction is completed, the local farmers are made responsible for the operation, maintenance and rehabilitation of the tertiary system with technical supervision by the government. The government is responsible for the conveyance system from the headworks to the supply canals (primary and secondary canals).

Results from field studies reveal that normally little cooperation exists between the government and the farmers in the operation and maintenance of the irrigation system. This may have resulted from the inability of both sides to accomplish their tasks.

Because of limited funds and personnel, the government has difficulty in carrying out proper operation and maintenance of the main system. For example, in 1975 the funds available for maintaining more than 15 km of the First West Situbondo main system were only sufficient to mobilize ten people. Accordingly, one technician (government paid) with primary school education was responsible for operating and maintaining almost 2 km of secondary canals, with 3-5 offtakes (Tables 8 and 12). Consequently most secondary canals have deteriorated due to poor maintenance. A similar situation is found in the LIS, where the reservoir is completely filled with sediment, and several parts of the main canal have been destroyed. In the LIS, one technician is responsible for operating five main gates in different systems.

The farmers are dissatisfied when the distributed water made available at the tertiary offtake gate is insufficient. If a shortage of water occurs, farmers try to obtain as much water as possible through their own or joint efforts. In the First West Situbondo Irrigation Scheme it is usual for a group of farmers to hire a person with strong influence in the area to authorize the unofficial distribution of water. As a result, equal water distribution among the secondary and tertiary canal users can never be accomplished, as shown in Tables 13a and 13b. In extreme cases of uncontrolled water distribution some farmers destroy the canals, gates and diversion boxes.

Tables 13a and 13b also show that farmers whose rice fields are located in the middle of the secondary and tertiary canals have less chance of receiving adequate water than those at the head and tail. The tail rice fields receive more water than the middle section due to poor drainage in the irrigation system.

Comparing the three irrigation schemes, the SIS shows the best water management practices. Here the village leader has a strong influence over the farmers, enabling him to control the utilization of irrigation water efficiently.

ii. Lack of sustained local level action

Usually farmers are not involved

[1] Korten F.F. Community participation: a management perspective on obstacles and options. In: Bureaucracy and the Poor. D.C. Korten and F.B. Alfonso (eds.). Kumarian Press, Connecticut, USA. 1981. pp. 181-200.

Table 12 QUALIFICATIONS OF PERSONNEL INVOLVED IN OPERATION AND MAINTENANCE OF THE FIRST WEST SITUBONDO IRRIGATION SCHEME STUDY AREA

Location	Canal unit services	Position	Formal education Vocational school	Primary school	Without	Experience years 5	5-10	+10	Serviced area (ha/person)
Waringin Anom	Secondary	Juru	1	-	-	-	-	-	282
		Pakarya	-	2	-	-	-	2	291
	Tertiary	Ulu-ulu	-	-	4	-	-	4	146
Alas Malang	Secondary	Juru	-	-	-	-	-	1	531
		Pakarya	-	2	-	-	-	2	266
	Tertiary	ulu-ulu	-	-	3	-	-	3	70
Duwet	Secondary	Juru	1	-	-	-	-	1	829
		Pakarya	-	-	1	-	-	1	829
	Tertiary	ulu-ulu	-	3	-	-	-	3	104

Table 13a SUFFICIENCY IN WATER SUPPLY OF SECONDARY CANALS IN THE FIRST WEST SITUBONDO MAIN CANAL SERVICE AREA

Secondary canal location	Farmers with sufficient water Wet season No.	%	Dry season No.	%	Total no. of farmers No.	%
Head secondary canal	18	19	14	15	32	34
Middle secondary canal	21	22	3	3	24	25
Tail secondary canal	27	28	12	13	39	41
Total	66	69	29	31	95	100

Table 13b SUFFICIENCY IN WATER SUPPLY OF TERTIARY CANALS IN THE FIRST WEST SITUBONDO MAIN CANAL SERVICE AREA

Tertiary canal location	Farmers with sufficient water Wet season No.	%	Dry season No.	%	Total no. of farmers No.	%
Head tertiary canal	21	22	10	11	31	33
Middle tertiary canal	25	26	7	7	32	34
Tail tertiary canal	20	21	12	13	32	34
Total	66	69	29	31	95	100

in the development of the irrigation system. For instance, when the First West Situbondo Irrigation System was rehabilitated (including the tertiary system) only 11.2 percent of the local farmers were involved in the preliminary investigation, and 4.5 percent in the design process. Those farmers who were involved were mostly village leaders, and their participation concerned mainly the administrative aspects. Farmers were not questioned about their needs from the irrigation system to be developed.

Such development leads to a gap between the farmers and the government. The government wishes the farmers (or a group of farmers) to take up the responsibility for the operation and maintenance of the tertiary system, while the farmers, on the other hand, are not familiar with the system. Therefore, they allow the irrigation structures to deteriorate and fall into disuse. To narrow this gap, a commitment for more efficient operation and maintenance should be made between the government and the users (farmers). This may be accomplished by giving more opportunity to the farmers to be involved in the development and the rehabilitation of the irrigation system.

iii. Limited adaptability to local circumstances

The irrigation system is commonly designed by people who have little familiarity with the actual needs of the people they intend to benefit. As a consequence, there is often a poor fit between the designed irrigation system and the needs of a given community. The use of irrigation water becomes inefficient and available water is wasted. On the other hand, it is not an easy task to achieve a construction which is adapted to local conditions.

There are two main constraints encountered in the endeavour to obtain an adapted design and construction:

a. During the construction process, which is separated from the design, possibilities for an adjustment to local conditions are very limited.

b. The topographic map used in the design often does not include a longitudinal section, as prescribed in the design procedure. The Indonesian standard design for a new tertiary system in flat or undulating areas uses a topographic map of scale 1:2000 with a vertical interval of 50 cm. For an old system, a topographic map with a scale of 1:5000 for a 50 cm vertical interval is considered sufficient. Since the length of the tertiary canal or the distance between two adjacent structures in the tertiary system are less than 20 m, the use of a topographic map of the scale 1:2000 without a longitudinal section increases the possibility of misplacing the structures. This is apparent in all three sample studies.

iii. The creation of dependence

The irrigation development programme is intended to improve farmers' capability in food production through efficient use of water. If farmers are not involved in the development process, the programme often has a negative impact, and increases the farmers' dependence on government support. If this occurs, the rehabilitation of the tertiary system will not be successful, especially in the operation and maintenance, which are the farmers' responsibility.

The tendency of increasing dependence is more prominent whenever the improved system is not well adapted to the local conditions and the development process is not well organized. Two examples of such cases are found in the PSIS as well as in the LIS.

In the PSIS, 79.8 percent of sample farmers expressed their satisfaction with the rehabilitation works, even though only 11.2 percent were involved. Unfortunately, the main reason behind their satisfaction is not based on the better performance of the rehabilitated system, but on their consideration that the government is fully responsible for the works. Therefore, after the rehabilitation is completed, they consider that the operation and maintenance programme is also the responsibility of the government. The situation becomes more severe when the sugarcane intensification programme (TRIS) is introduced in the irrigation scheme. To compensate for the destruction of the existing quaternary system, the TRIS provides an extra fund to rehabilitate the quaternary canals. Besides this, the TRIS provides an extra fund to promote better water management. As the extra funds are paid to the sugarcane farmers directly, other farmers who are not included in the programme become reluctant to manage the system properly unless they also receive the extra payment. The TRIS programme is also found in the SIS.

The situation in the LIS differs from that of the PSIS and the SIS. When the rehabilitation of some parts in the main system is completed, farmers feel that the programme does not give any advantages. Consequently, farmers are reluctant to improve the tertiary system before they are sure that the government improves the reservoir. Without the improvement, the farmers feel that their efforts to improve the tertiary system are useless.

3.2 Linkage between government efforts and farmers' attitudes in developing and utilizing irrigation systems

The first part of the analysis shows that many factors contribute to the

existing gap between the government efforts and the attitudes of the farmers toward an efficient use of irrigation systems. The interaction between the different factors complicate the process of encouraging farmers to participate in the development of irrigation systems.

To solve the problem, special efforts have to be made to create a link between the objectives of the development programme launched by the government and the farmers' attitudes to participating in the programme. To make the linkage work, it should be developed taking into account the existing constraints encountered by both sides. This linkage can be set up through the following efforts:

i. Development of cooperation among the farmers in the scheme for efficient water use: Within this concept, equal water distribution should be the base for an optimal use of water available in the scheme. The cooperation of farmers in water use requires a strong organizational structure which is acceptable and workable in the command areas.

ii. Involvement of farmers in the development programme: Once cooperation for efficient water use has been established among the farmers, the irrigation development programme can be set up. Since government funds and personnel are limited, the participation of farmers in this development should not be restricted to the tertiary programme only. Also better results are obtained the earlier farmers participate in the development.

iii. Improvement of planning, design and construction: The results from the study in three sample areas in the irrigation schemes (the PSIS and the LIS) showed that many irrigation structures failed to function. This condition resulted from improper planning, design and construction. If farmers are to be involved in the development programme, such deficiencies have to be eliminated, otherwise farmers will withdraw their participation, and will not be easily persuaded to participate again. Possible efforts which may be appropriate to improve the planning, design and construction are:

   a. utilizing a better topographic map than the existing one with a 1:2000 scale and 50 cm vertical interval for design purposes;

   b. increasing flexibility in design so that it can be adapted as necessary during construction;

   c. giving more opportunity to the farmers in the development process, from planning to construction. Many tertiary structures could be built by the local farmers;

   d. revising the existing sequence of construction works such that, starting from the offtake point, structures are built following the downward flow of water.

iv. Improvement of coordination among agencies involved in development: To improve the planning of cropping patterns, management of available water, maintenance of the irrigation structures, and provision of funds for operation, better coordination is needed between the agencies involved in the management of the irrigation system.

4. CONCLUSION

The role of farmers' participation in the success of irrigation development is prominent. However, farmers' participation in irrigation schemes developed by government is relatively small. Many factors influence the process, both from the side of the government and the farmers. They can be summarized as follows:

- limited water resources;
- limited personnel available to manage the system;
- communication and technical gaps between the government agency and farmers. As a result, farmers do not know the objectives of the irrigation development, their responsibilities and the proper management requirements;
- improper design and construction on site resulting from limited data available and the shortcomings of the existing construction procedures to be followed by the constructor;
- the existing management system which separates the management of the main system from that of the tertiary system;
- the uncertainty in the planning of water utilization in the command area.

These factors affect farmers' participation in the form of a chain process which makes it difficult to assess the individual effects. The result is that the irrigation system is not adapted to the local conditions, it falls into disuse, deteriorates and creates farmers' dependency.

There are several possible ways of overcoming these problems. The first priority is to establish cooperation between farmers in the efficient utilization of water. This should be followed by an improvement of procedures for planning, design and construction, giving more opportunity to the farmers to participate in the development of the irrigation system.

The success of small-scale irrigation development in many places in Indonesia which is carried out by farmers themselves can be used to encourage farmers' participation in large-scale irrigation projects.

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FARMERS' INVOLVEMENT IN IRRIGATION DEVELOPMENT IN THE PHILIPPINES

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1. DESCRIPTIVE BACKGROUND

1.1 General

The Philippines is an archipelago in Southeast Asia, with a total land area of about 29.7 million ha of which about 10 million ha are considered arable. There are sixteen islands which are of importance in terms of irrigation development and two of these, Luzon and Mindanao, comprise about two-thirds of the land area of the entire archipelago. The islands are generally mountainous and hilly. Only about one-third of the total area of the archipelago is cultivable.

The physiography of the country is complex. The archipalego was is of volcanic origin and earth movements produced numerous mountain ranges dividing the islands into isolated alluvial plains and small watersheds with short and rapidly flowing rivers. The largest stretches of plains are in the islands of Luzon and Mindanao. In the other islands, numerous pockets of arable land are found in the valleys of small watersheds. The predominant soils are clay loams and sandy clays derived from basalt andesites, volcanic rocks, and limestone as a result of weathering. These soils are found in the plains and valleys as deep alluvial deposits. In volcanic areas, volcanic ash and tuff are mixed with these deposits. The soils in the lowlands are usually heavy in texture and well suited for paddy production. In the higher areas, the soils are generally deep and loamy with moderate to good internal drainage.

The climate of the archipelago is tropical and monsoonal with an average temperature of 27°C throughout the year. The annual rainfall varies in amount and pattern of distribution in four principal climatic types. The average annual rainfall is about 2000 mm and there is a dry season and a wet season in practically all parts of the country with the length of the dry seasons varying from 3 to 7 months depending on the region and its climatic type. The archipelago lies in the typhoon belt and many islands are liable to extensive flooding and damage during the typhoon season from June to December. The frequency of typhoons is greater in the northern portion of the archipelago than in the southern. Usually two or three strong typhoons pass the country annually and another two or three with lesser intensity.

Of the total arable area of about 10 million ha, about 9 million ha are devoted to agricultural production of which about 3.1 million ha are for paddy, 3.2 million ha are for other food crops such as maize, fruits and vegetables and 2.7 million ha are in commercial crops such as coconuts, sugarcane and abaca. Agricultural production continues throughout the year. About 1.3 million ha of land during the wet season and about 700 000 ha during the dry season are served by irrigation facilities. The principal irrigated crop is rice, accounting for more than 96 percent of the irrigated crop area. As less than half of the total area devoted to rice production is irrigated, the national average paddy production is only 2.1 tonnes/ha. Unirrigated rainfed areas average only 1.25 tonnes/ha while well irrigated areas produce 4 to 6 tonnes/ ha.

Agriculture is the dominant sector of the country's economy. It accounts for about 30 percent of the gross domestic product, 60 percent of foreign exchange earnings, and more than half of total employment. About 70 percent of the 48.7 million population live in the rural areas where more than three-quarters of the households depend on farming as the main source of livelihood. The size of the average rice farm is only about 1.5 ha and the average per capita income is about US$ 120 a year. Population growth is 2.4 percent annually, a decrease from the 2.7 percent growth of ten years ago. The best lands are now under cultivation and only marginal areas remain to meet the needs of the increasing population. Thus most of the increases in production required in the future must come from higher yields and cropping intensities.

It is estimated that more than 50 percent of the land tenure in agriculture is still under tenancy arrangements. In the rice and maize areas, however, the percentage of tenancy has decreased due to the government programme of agrarian reform started in 1972 for transferring land ownership to tenant farmers from landowners who have more than 7 ha of rice and maize lands. This involves about a million tenanted farms covering some 1.5 million ha. Recent reports indicate that certificates of land transfer have been issued to more than 420 000 tenants farming 645 000 ha. Areas devoted to coconuts, sugarcane, abaca and other commercial crops are not yet covered by the land reform programme.

The government has given priority to the development of the rural areas, especially the provision of agricultural support services. The Ministry of Agriculture is strengthening its extension service by providing, nationwide, an average of one agriculture and food technician for every 104

farmers. Other institutions providing technical support to farmers are the various credit institutions, rural banks, the Ministry of Agrarian Reform and the Farm Systems Development Corporation. The National Food and Agricultural Council coordinates the activities of all national agencies in food production. This is replicated at regional, provincial and project levels by appropriate coordinating mechanisms among the agencies involved.

1.2 Irrigation Systems Development

In terms of ownership, irrigation systems in the Philippines are generally grouped in three categories: national, communal, and private. The national systems are constructed, operated, and maintained by the national government through the National Irrigation Administration (NIA). Irrigators in these systems are obliged to pay the NIA irrigation fees equivalent to 100 kg of paddy/ha during the wet season and 150 kg of paddy/ha during the dry season in the run-of-the-river gravity systems. In systems with storage reservoirs, the rates per ha are 25 kg of paddy higher per season. In pumping systems, the rates are much higher and are set on a case to case basis, influenced heavily by the cost of operation and maintenance and after consultation with the water users. In early 1984 there were 116 national systems irrigating about 490 000 ha.

Communal systems are owned, operated and maintained by groups of farmers and are constructed with or without financial and technical assistance from the government. Some of these systems were constructed during the Spanish colonial period and a few, such as those in the rice terraces in Ifugao and Mountain Province, were in existence prior to Spanish colonization. During the American period following the end of Spanish rule, communal systems continued to be built. At the end of the American regime, it is estimated that there were more than 300 000 ha covered by communal irrigation systems. Most had simple temporary low dams of logs, stone, and brush built on mountain streams to divert river flow to lowland rice fields through earthen canals. Thus communal systems have had a much longer history than national systems. The first irrigation project which became a national system after construction by the government was completed only in 1923. On the other hand, while communal systems had long been in existence, assistance by the government to systems of this category started only in the early 1950s. This assistance has grown steadily since then, to cover more than 380 000 ha by the end of 1983.

Private irrigation systems are those constructed, operated and maintained by an individual to serve his own land and often that of a few neighbours. Most are small pump systems drawing water from rivers and lakes and groundwater sources. The pumps are usually diesel driven, mostly 10 to 15 cm diameter sizes, obtained by the individual farmers from the government on an easy instalment basis. It is estimated that about 250 000 ha are covered by private irrigation systems consisting of pump systems and a good number of gravity systems constructed by the owners of big landholdings.

Rice is the principal staple of 80 percent of the Philippine population. Prior to 1977, the Philippines had been importing rice. The government had long considered this an undesirable situation and in the late 1960s decided to launch an accelerated irrigation development programme as the key to achieving rice self-sufficiency. The construction, improvement and rehabilitation of irrigation systems and the small pump distribution programme for private systems were given high priority. During the period 1970-80 more than 750 000 ha of land were furnished with new or improved irrigation facilities. This represents more than one-half of the present irrigated area of the country. Rice self-sufficiency was achieved in 1977.

At the same time, a new general policy on irrigation was promulgated. The policy stipulated that the government shall bear all the interests on the cost of construction of national and communal irrigation systems that it constructs or improves, and the irrigation water users shall bear the cost of operation and maintenance and pay back the cost of construction or improvement without interest within a period not exceeding 50 years. The policy further stated that the level of such payments or irrigation fees should not be a disincentive to the water users to benefit from irrigation, and that such irrigation fees should be within the paying capacity of the farmer. The costs to be repaid shall be only those for irrigation and agro-drainage facilities within the irrigated areas of the systems and shall not include the cost of roads, flood control, reforestation and power generation.

Responsibility for overall irrigation development in the Philippines rests with the National Irrigation Administration (NIA), a government corporate

entity governed by a six-man Board of Directors, with an Administrator as Chief Executive Officer. The NIA has offices in the twelve regions and in 68 provinces of the country. As of early 1984, the NIA was undertaking the construction of 33 new national irrigation projects with a total service area of 287 000 ha, improving 42 national irrigation systems serving 81 300 ha of presently irrigated areas and 49 000 ha of new areas, constructing new or improving existing communal irrigation systems covering more than 40 000 ha, operating and maintaining 116 national systems irrigating about 490 000 ha, and extending assistance to farmers' irrigation associations on organization, irrigation systems management, and financial management.

Of the total 1.3 million ha presently served by irrigation systems, about 1.11 million ha are under gravity systems and only about 190 000 ha are irrigated by pump systems. In the areas covered by gravity systems, some 230 000 ha are served by systems with storage reservoir facilities: the Pantabangan Dam, Magat High Dam and the Angat Dam. The large gravity systems are invariably national systems. Although there are a few national systems which are less than 1000 ha, the average size is about 3000 ha, the two largest being more than 100 000 ha each, namely the Upper Pampanga River Integrated Irrigation System and the Magat River Irrigation System. The national irrigation systems have permanent concrete diversion dams, earth distribution canals, gated concrete distribution and control structures, gated permanent turnouts for water delivery to farmers' groups and farm-level facilities that vary intensity depending on local conditions. Where seepage is excessive, parts of main and distributary canals are lined with concrete. The new national systems constructed since 1970 as well as the old systems that have been improved are equipped with access and farm-to-market roads built on canal embankments that have been widened for that purpose.

Communal systems which have been extended through government assistance generally have permanent diversion dams like the national systems. In a few systems, where site conditions are favourable, only permanent gated intakes have been constructed to reduce the financial burden on the farmers. Government assistance invariably includes construction of main and distributary canals, permanent regulation and control structures, and access roads. Farm-level facilities are constructed by farmers themselves with technical assistance from the NIA. In systems not yet assisted by the government, the diversion structures are usually temporary, constructed with logs, rocks, and brush, periodically damaged by floods, and reconstructed from time to time by the farmers. There are also no permanent headgates for regulating the entry of water into the system.

Under normal conditions the irrigation systems with reservoir storage can raise two rice crops a year, but in the run-of-the-river types the available water during the dry season invariably diminishes drastically so that on the average only about half the wet season is irrigated. In the pumping systems, especially the small units being amortized by individual farmers from the government, the number of operating pumps have decreased and the irrigated area has been reduced from more than 250 000 ha to the present estimated 190 000 ha due to increased costs of energy for operation.

For the national systems as well as the communals assisted by NIA, the planning, design and construction is undertaken by NIA. In the case of communal systems, farmers' involvement in these processes is actively pursued and is generally extensive. An irrigation association is organized before construction and registered with the Securities and Exchange Commission. Farmers participate in locating the diversion site, the canals and the turnout structures, and take responsibility for the acquisition of right-of-way for the canals and the water rights of the system. Construction is started only after the irrigation association has signed a contract with NIA stipulating that the association is responsible for the operation and maintenance of the system and that it will repay without interest the costs of the irrigation facilities constructed by the NIA in accordance with goverment policy. Generally, a counterpart from the irrigation association is required amounting to 10 percent of the cost of construction but sometimes this is reduced when the cost of construction is high and the resources of the association would be severely strained.

The planning, construction, operation and maintenance of national systems has been done only by the NIA. In the past two years, however, pilot programmes in national irrigation systems covering 23 000 ha throughout the country have been established for organizing farmers to participate in the planning and construction of the rehabilitation and improvement of

minor distributary canals and the farm-level facilities, after which they will assume certain responsibilities for operation and maintenance under a formal agreement with NIA. Depending on the capability of the irrigation association, these responsibilities range from clearing and maintenance of canals to distribution of water and collection of irrigation fees.

1.3 Irrigation Management Problems

National irrigation systems are managed by the NIA and communal irrigation systems are managed by irrigation associations with assistance from the NIA as may be needed. In the national systems, the most pressing management problem is the inadequate level of collection of irrigation fees compared to the cost of operating and maintaining the national systems. This is a crucial problem because irrigation policy as approved by the President of the Philippines requires that the cost of operation and maintenance of the national systems be fully defrayed from irrigation fee collections. Thus the government subsidy for operation and maintenance which used to be 60 million pesos a year was gradually phased out. For the year 1983, total operation and maintenance costs amounted to ₱99 million. On the other hand, irrigation fee collections were ₱77 million, equivalent to 63.5 percent of the total irrigation charges collectable for the year, thus resulting in a deficit of ₱22 million. The annual deficits in previous years were greater. Studies indicate that this situation is the result of the following technical and institutional problems:

i. dissatisfaction of a significant portion of the farmer-clientele with the adequacy and timing of water deliveries due to (a) interference with water distribution by other farmers, (b) water shortage, (c) faulty or damaged distribution structures, and (d) poor maintenance and general deterioration of facilities;

ii. low paying capacity of farmer-clientele due to (a) low price of paddy during harvest time, (b) low yields, (c) debts for rentals on the land and interests on credit, (d) high cost of production, and (e) crop damage by typhoon, pests and diseases;

iii. the difficulty of bringing to court delinquent farmers, especially the big influential landowners, in order to force collection;

iv. the attitude that still remains among a significant number of farmers that the irrigation service should be free as it is being furnished by government; and

v. health problems due to schistosomiasis in some areas.

In communal irrigation systems, where management is the responsibility of the irrigation association, the main problem is the viability of the association which depends upon the following institutional and technical problems:

i. the process of organizing the irrigation association;

ii. the way the irrigation systems are planned and constructed especially the adequacy of water supply relative to the service area and the design and construction of the diversion works and distribution system;

iii. the capability of the irrigation association leaders to manage the system effectively in terms of equitable water distribution, settlement of conflicts, system maintenance and budgetary needs;

iv. the contributions both in cash and labour which members make to the maintenance of the system and to meet other obligations of the association; and

v. the understanding of the members on the proper use of irrigation water.

1.4 Irrigation Improvement Programmes

To address the identified technical and institutional problems in national systems NIA has taken a number of steps, the first of which was the rehabilitation and upgrading of all old national systems throughout the country. Sixty-nine systems serving 255 000 ha were brought under this programme. Sources of funding were loans from the World Bank, the Overseas Economic Cooperation Fund of Japan, and the Asian Development Bank in addition to Philippine Government appropriations. The programme included improved irrigation planning and design, repair of diversion works where needed, construction of necessary additional distribution and control structures, desilting and rehabilitation of canals and structures, construction and rehabilitation of drainage facilities, installation of gates and measuring devices for

effect[illegible] water control, construction of farm co-market roads and farm level facilities, provision of equipment for operation and maintenance and training of O&M personnel. In systems with schistosomiasis, health measures were added to control and eradicate this water-borne disease.

The old systems had no roads and lacked terminal level facilities. To upgrade these systems, farm ditches were constucted to serve directly most of the farmers' fields, and drainage ditches were added. The new farm-level facilities averaged 50 m/ha for farm ditches and 30 m/ha for drainage ditches. Permanent turnouts with measuring devices were constructed for more efficient water delivery to service areas ranging from 30 to 50 ha per turnout.

O&M, farm and access roads were constructed on the canal embankments. The average density of these roads was about 1 km for every 70 ha of service area. Canals carrying flows greater than 5.0 m^3/s were provided with roadways 5 m wide on both embankments where the service area was only on one side. Canals for flows from 2.0 to 5.0 m^3/s were provided with roads 3.5 m wide on one embankment.

One of the principal constraints identified in the operation of the systems was the attitude and lack of cooperative group action by the water users. Pilot programmes were established to help organize the farmers. At the end of 1983, there were 26 pilot projects covering an area of over 23 000 ha.

In the case of communal irrigation systems, NIA studied old existing communal systems that have been able to operate and maintain their facilities satisfactorily throughout the years. It was observed that these systems were originally planned and constructed by the farmers themselves with no assistance from the government. Their organizations have strong support from the farmer members and are administered in accordance with rules derived from the general membership. Every member knows and accepts his responsibilities in the organization.

NIA had made previous attempts at organizing irrigation associations but the methods it employed produced little involvement from the general membership and had failed to develop "grass roots" support. NIA also made arrangements with the Farm Systems Development Corporation (FSDC) to organize farmers in communal systems for NIA, but the results were not satisfactory. After studing the old communal systems that had strong "grass roots" support, NIA decided to pilot a new organizing process which would employ an approach designed to induce farmer participation in all phases of the development of a communal irrigation system.

To implement the participatory approach, NIA had to improve both the technical and institutional aspects of communal irrigation along the following lines:

i. improved project data gathering for more reliable information on water supply, soils, topography, and crops and, in addition, farmers' attitudes, willingness to participate, leadership patterns, existing organizations and probable institutional problems;

ii. improved planning, design and construction of projects;

iii. better programming of budgetary support for projects and increased emphasis on the counterpart participation of farmers;

iv. development of processes that induce farmers' participation in planning and construction;

v. training of irrigation commnity organizers, technical staff and supervisors on the participatory approach for organizing farmers;

vi. assistance programmes for developing the capability of irrigation associations in irrigation systems management and financial management.

The processes that were developed for the communal systems were likewise employed with modifications in the pilot areas for the national systems.

2. PROGRAMMES TO INVOLVE FARMERS

The NIA started the participatory approach to communal irrigation development in two pilot areas in Laur, Neuva Ecija: (i) the Pinagbaryuhan Irrigation System covering a proposed irrigable area of 1600 ha and (ii) the Bagting-Siclong Irrigation System proposed for 600 ha. The objective of the NIA was to test processes for developing grass roots capability to participate in (i) decision making within an irrigation association, (ii) planning improvements and expansion of an irrigation system, (iii) securing water rights and rights of way, (iv) construction of irrigation facilities and (v) control of construction costs.

The concept was to start construction of facilities for improving and expanding the two irrigation systems only after the farmers had been properly organized to participate in these five areas of activity.

Six community organizers (COs) were fielded in the two pilot projects managed by one programme coordinator. The COs lived within the community of the farmers, joined planting and harvesting activities, funerals, church festivities, social functions, and conducted house to house visits to integrate with the community. Having gained acceptance, they began to talk with farmers about their irrigation system, the need for expanding the service area, maintaining the system and a strong irrigation association. Meetings were held with the COs furnishing guidance to ensure open communication among the farmers. The extent of assistance to be requested from the NIA was defined and negotiations for the assistance were subsequently conducted by the farmers with the NIA.

In both systems, there were existing farmers' associations which had to be tested, reoriented and strengthened into strong irrigation associations. Having completed negotiations with NIA on the improvement and expansion of their irrigation system, the farmers in Bagting-Siclong with guidance from COs, organized committees for (i) surveys, (ii) right of way acquisition, (iii) revision of by-laws, (iv) registration of the irrigation associations with the Securities and Exchange Commission, (v) labour mobilization, (vi) materials checking, (vii) water rights acquisition, and (viii) repayment of construction costs. The farmers, starting from the grass rots level with guidance from the COs, re-examined the structure and revised the by-laws of the existing association and formally registered their new association with the Securities and Exchange Commission. The association then entered into a contract with NIA stipulating that NIA would construct the irrigation facilities and the association would repay its cost without interest and assume operation and maintenance of the system after construction.

The same process was followed in the Pinagbaryuhan System, although progress was much slower on account of the much larger area and the conflicts within the existing association that repeatedly frustrated grass roots participation in the internal decision making. Negotiations between the association and the NIA were deferred until after the internal conflicts were resolved, extensive grass roots participation developed, and the association strengthened and registered with the Securities and Exchange Commission.

In the participatory processes developed in the two systems, farmers prepared a map of the proposed irrigation service area, indicated where they would like the canals to pass, discussed these with the engineers and accompanied them during the surveys for the planning and design of the system. The farmers subdivided the service area into sectors and conducted sectoral meetings for revising and ratifying their by-laws. They registered their association, acquired water rights from the National Water Resources Council, secured rights of way for canals, assisted NIA survey parties in locating canals and structures for design and construction and decided among themselves on how to operate and maintain the irrigation system and repay the cost of improvements.

During construction the association mobilized labour by sectors. A substantial portion of the labour costs was given without payment from NIA as part of the associations' counterpart contribution. Various committees checked the use of construction equipment, the consumption of fuel, the quality and quantity of the material being delivered at the construction site, and the procurement costs of these materials.

In these pilot projects NIA made the assumptions that: (i) as the farmers have to pay for the construction costs of the improvements on the system they should have a considerable say in what is built, (ii) farmers' involvement in the planning and construction develops their sense of ownership of the system and hence their desire to operate and maintain it properly, (iii) farmers' knowledge of local conditions can contribute to better planning and design of the system and facilitates acceptance of the improvements after completion, (iv) their involvement during the planning and construction provides practice in group decision making and in the necessary interaction among the members and leaders that develops their skills and confidence for managing the system after its completion.

These assumptions were generally validated in the two pilot projects and, in addition, NIA learned that to develop farmers' participation:

- The COs should be given enough lead time for organizing and

mobilizing farmers prior to construction. In the smaller system of 600 ha this required ten months. In the larger system, about twice as long.

- Engineers should have more understanding of irrigation institutional development factors and processes to gain flexibility in their attitudes towards farmers and COs. An appropriate training programme was needed.

- NIA policies and procedures that obstruct farmers' participation had to be revised.

- Engineers and COs had to work together closely to integrate technical and organizing activities.

The processes developed in the first two pilot projects, although generally effective, were not entirely conclusive. Furthermore, it had a number of shortcomings which had to be corrected before replication on a larger scale. For improving the process, NIA used another pair of pilot projects in the province of Camarines Sur where the cultural conditions of the people were different from those in the first pair. The two projects followed the same strategy and method and added the following elements:

i. For promoting the integration of technical and institutional activities a flow chart was developed synchronizing the various elements of both within a framework of eight to nine months of farmers organizing activities and NIA technical activities prior to construction.

ii. The identification of areas where NIA had to develop mechanisms for dealing with farmers and promoting their participation. Among these were procurement procedures promoting farmers' participation, direct contracting procedures with farmers' groups for construction work they were capable of undertaking, preparation of paddy elevation maps of farmers' fields, and more expeditious funding procedures to enable better preparatory technical and organizing work.

iii. The identification of the training needs of engineers and community organizers. The two pilot projects were documented by social researchers. Problems were identified from the documentation and case studies were developed.

iv. The development of a manual on financial management for communal irrigation associations which was carried out in consultation with farmers.

v. A programme of activities for developing a water management manual for communal irrigation systems.

In developing the participatory approach to communal irrigation, NIA received considerable assistance from a number of agencies. The pilot projects in Laur were partially funded by a grant from the Ford Foundation in 1976. As the programme developed, the Foundation continued its financial support and made available one of its programme officers to NIA from time to time.

The start of the programme drew the interest of other institutions: the Asian Institute of Management (AIM), Institute of Philippine Culture (IPC) and the International Rice Research Institute (IRRI). AIM was working on rural development processes and saw the potential of the participatory approach for mobilizing the rural population. IPC was doing social research on indigenous Philippine irrigation systems and had a continuing interest in irrigation associations. IRRI was working with NIA on irrigation research and was interested in the development of strong irrigation associations for better water management. After working together informally for a time, representatives from the Ford Foundation and these institutions decided to organize formally into a committee to assist NIA in conducting research, training and other activities for improving communal irrigation. Three other institutions (the Institute of Agricultural Engineering of the University of the Philippines, the Farm Systems Development Corporation, and the Economic Development Foundation) were invited to join and the establishment of the Communal Irrigation Committee (CIC) was approved by the NIA Administrator with an NIA Assistant Administrator as Chairman.

The CIC was a working committee. As assisting the NIA required capability in handling interdisciplinary problems, the CIC had membership with skills in irrigation engineering, agriculture, anthropology, sociology, management, economics and training. The committee met at least once a month to review progress, address problems, and agree on activities. The Institute of Philippine Culture brought into the committee experiences from research work on old communal irrigation systems. It undertook

process documentation of irrigation organizing work, construction activities, and operation and maintenance in completed projects. The products of documentation were discussed in the monthly meetings. IPC prepared procedures for prearing socio-technical profiles to assist NIA in its feasibility studies for communal irrigation projects and then trained NIA personnel in gathering data and writing the socio-technical profiles.

AIM, with its rich experience in training and management, assisted in orienting NIA engineers and other technical staff into the participatory approach to irrigation development. It prepared and conducted training programmes for NIA engineers to develop their capacity for managing the construction of projects along the participatory approach. It conducted workshops for developing coordination between engineers and community organizers. It helped during review sessions in addressing management issues and problems, and prepared case studies for use in training.

Even before the participatory approach programme, IRRI had been working with NIA in irrigation research. In joining the CIC, the representative from IRRI assisted in a retrospective study of previous communal irrigation projects of the NIA, helped prepare training procedures in irrigation systems management for communal irrigation associations, trained engineers in farm-level facilities design and introduced the process of paddy elevation mapping.

The Ford Foundation provided partial financial support and encouragement to the programme. From 1976 it provided financial assistance every two years, the total of which reached just below $1 million. Its programme officer provided advice and assistance to NIA and the other members of the CIC.

By the end of 1979 enough experience had been gained from the pilot projects in Nueva Ecija and Camarines Sur for expanding the programme to all regions of the country. The Regional Irrigation Directors of the NIA were gathered in a conference initiated by the CIC and agreements were forged to start a pilot project in each region. Thirty community organizers were selected through a rigid screening process and then given initial training for three weeks on the basics of irrigation and the NIA organizing process. Workshops were held between engineers and community organizers during which project profiles were discussed and analysed. Members of the CIC and engineers and community organizers with experience from the Laur and Camarines Sur pilot projects served as resource persons who furnished guidance to the workshop participants. Engineers were trained in planning and construction policies and procedures that promote participation of farmers. The outputs of the workshops were planning and construction schedules for each pilot project that were synchronized with the organizing activities.

Construction of 12 regional pilot projects has been completed and additional projects are now being implemented using the participatory approach. The irrigation associations have accepted the irrigation systems and are now undertaking their operation and maintenance. They have been given assistance by NIA in developing their operation and maintenance processes through an irigation systems management training that gives the irrigation associations processes, rather than ready-made plans. Thus an association develops its capability not only for preparing its systems management plan but also for improving on it. The training consists of processes for developing a cropping calendar, a normal water distribution plan, a crisis water management plan, a conflict management plan, a maintenance plan, and a farm-level facilities development plan. In addition, a separate financial management training is given by NIA to the irrigation associations to enhance their capability in budgeting, basic accounting, and billing and collection procedures.

Each association decides on the structure of its organization and formulates its own rules. Members contribute both labour and cash or paddy for maintenance of the irrigation systems and repaying the chargeable costs of its construction as agreed upon between NIA and the association. The legal rights to the use of irrigation water are in the name of the association. Thus, it has the responsibility for distributing the water equitably and beneficially. As of the end of 1983, 76 communal irrigation associations had gone through the system management and financial management workshops. NIA has targetted at least 200 irrigation associations for these workshops every year for the next four or five years.

The programme to involve farmers has been extended from the communal systems to the national systems. Generally, there are three types of involvement in national systems. In the first type, organized farmers contract with NIA an agreed length of canal which the farmers' association main-

tains for a fixed annual payment from NIA. For a canal with a capacity of about 2 m^3/s the annual payment is about ₱2000 per kilometre. Major repair beyond the capacity of the association is undertaken by NIA. The association, in addition, assists the NIA watermaster in water distribution and in collection of irrigation fees. As an incentive the association is entitled to 2.5 percent of the collection in its area. This incentive is increased to 3 percent if collection is 100 percent. About 190 irrigation associations covering about 35 000 ha are involved under this arrangement in 31 national irrigation systems throughout the country.

In the second type, the irrigation association operates and maintains sectors of 250 to 400 ha defined by the canal layout. Each association collects the irrigation fees within its sector and remits it to NIA once a week or more often. NIA operates and maintains the headworks and main canal to the head of the service area. The associations operate and maintain the rest of the system; however, major repair is undertaken by NIA. The associations are given training and guidance in irrigation systems management and financial management.

Pilot implementation of the second type of farmers' involvement in national systems started with the fielding of community organizers in the Buhi-Lalo Irrigation System in December 1980. Originally covering 1000 ha, this system was being expanded to 3000 ha. The processes used for organizing farmers in the communals were used with modifications for the nationals. About two years later, additional projects were established in 12 national systems throughout the country following the processes in the Buhi-Lalo System. At present the programme covers more than 23 000 ha in 26 national irrigation systems.

Three of the irrigation systems, with a total of ten irrigation associations (IAs), have turned over 3000 ha of service area to the IAs for operation and maintenance. Under agreements with the NIA, the IAs within their sectors maintain the canals, do minor repairs, distribute water according to agreed schedules, collect irrigation fees and remit the collections to NIA. The agreements stipulate the obligations of both parties and the method of sharing the collections between NIA and the IA, which on the overall is usually on a 50:50 basis. As in the communal systems, NIA gives the IAs training in irrigation systems management and financial management. Associations in nine other national systems are in the process of negotiating with NIA for taking over operation and maintenance of their sectors.

In the third type of farmers' involvement in the national systems, the objective is to have the irrigation association take over the operation and maintenance of the entire irrigation system from the NIA. In effect it is converting the national system to a communal system. Over a period of ten years NIA expects to be able to do this for all existing national systems of about 2000 ha or smaller. However, these systems will pass through the second type of arrangement as a preparatory stage excepting five very small ones totalling 700 ha which have been entirely turned over to farmers as communal systems during the past two years.

2.1 Strategies to Involve Farmers

A prerequisite to choosing a strategy for achieving farmers' involvement in irrigation development is a basic, deliberate decision of the irrigation agency regarding the level of involvement it desires from farmer beneficiaries of an irrigation system. In the communal systems, the NIA decided that farmers should participate and interact with NIA in decision making and that this participation should progress from planning to construction of their irrigation facility and finally to its operation and maintenance. In the pilot national systems, considering their larger areas, participation in planning and construction was limited to the smaller distributary canals and the terminal level facilities and then extended to the whole system during operation and maintenance. In both cases the strategy that evolved to attain the objective had two elements:

- Farmers' participation had to be organized. Otherwise, it would not be sustainable and might even be dysfunctional.

- NIA had to develop capability in responding positively to organized action by the farmers and in carrying out its programme for developing irrigation associations. Otherwise the farmers would be frustated and discouraged from future participation.

To catalyse the farmers' organized action, NIA selected as the entry point for the organizing process the desire of the farmers to have an irrigation system responsive to their needs. Community organizers (COs) were

then fielded to induce the farmers to identify their irrigation problems and then participate in planning, design, construction and finally the operation and maintenance of irrigation facilities that would address their irrigation problems. The COs were trained in the basic organizing procedures of integration with the farmers' community, mobilization of farmers, and in the action-reflection process. In addition, they were trained in procedures for preparing farmers to undertake their roles as participants in the planning and construction of their irrigation facilities. In preparation for the operation and maintenance stage, the COs were trained in how to assist farmers, organized into irrigation associations, to prepare and implement their irrigation system management plans. Throughout the organizing process and the development of the capability of the irrigation association, the COs played an active role as catalyser in analysing, persuading, arguing and challenging but they were instructed never to take away the decision making from the farmers nor perform themselves the tasks which the association itself should undertake.

In new communal irrigation projects, the COs were usually fielded eight or nine months before the start of construction to ensure broad-based participation during project implementation. For the duration of the project, the COs lived in the farmers' community. The integration with the community was intensive and achieved through courtesy calls to the municipal mayor and other town or barangay officials, house-to-house visits to expected farmer beneficiaries, and attendance at social and religious gatherings. In this manner, the COs got to know people's names and backgrounds and identified potential leaders whom they could develop for the organizing work. In addition, the COs were able to identify organizational problems and potential sources of conflicts. During the integration period, the COs also validated and checked information on the scope of the project and the farmers to be benefitted.

For broad-based mobilization for participation, COs divided the irrigation service areas into sectors. In new projects where canal lines were not yet established the sectors were barangay based. Identified leaders were assisted by COs in conducting meetings to air problems and to decide on how to organize participation in developing an irrigation project or system that would be responsive to their needs. The work proceeded to a stage when all sectors agreed to form one irrigation association that would negotiate with the NIA for the construction or improvement of their irrigation system.

The activities of the irrigation association and the COs and the lessons learned, all of which are now being followed as standard procedure in the NIA communal irrigation development programme, have been discussed in a previous section on the NIA pilot communal projects. Basically similar procedures, with some modifications, have been used for pilot national irrigation systems as follows:

i. As canals are already existing, sectoring is canal based and each turnout service area is used as the basic sector. COs therefore validate farmers' listings per turnout service area and identify potential leaders for every such area. Farmers with assistance from COs conduct meetings by turnout service area to identify their irrigation problems and discuss solutions.

ii. Planning engineers, with assistance from COs, present and discuss with farmer groups improvement plans which may consist of additional canals, farm ditches, drainage ditches, and irrigation structures. Farmers and engineers together walk through the proposed location of the improvements. Farmers' suggestions are considered and incorporated where found feasible. The locations are confirmed and finalized.

iii. The farmers group into construction units and under contractual arrangements with NIA construct canals and facilities which they are capable of undertaking with guidance from NIA engineers. Thus the farmers validate their leaders and develop cooperative skills.

iv. As construction ends the COs motivate the turnout groups to organize into associations by zones of 250 to 400 ha, more or less, for negotiating with NIA the sharing of O&M responsibilities and the corresponding irrigation fee collections between NIA and the associations.

v. NIA conducts a training programme to assist the association in developing its systems management and financial management, and in generating the necessary contacts for agricultural extension services, credit and other inputs.

The activities of the NIA for organizing farmers and developing their capacity for participating in irrigation development would not be effective unless NIA also developed capability in responding positively to organized farmers' action. As the programme proceeded, NIA had to undertake the following activities in addition to those already mentioned:

- It developed a rigid screening process for COs to employ only those who had qualified after interviews which assess attitudes, communication skills, general intelligence and willingness to live in depressed rural areas. At the end of 1983, NIA had about 400 COs in the field in communal irrigation projects and pilot areas in national irrigation systems.

- It trained trainers and CO supervisors. These were selected from experienced COs and, in addition to their previous training, they had to be trained in supervision and coordination work, monitoring and evaluation of CO activities, and field training and guidance of COs.

- It identified and adopted procedures for promoting farmers' participation and amending those that discouraged such participation. These included developing processes for coordinating technical and farmers' organizing activities. Engineers were made to understand that construction of physical facilities alone does not constitute the whole of communal irrigation development. The development of the capability of the farmer organization to operate and maintain the system is also necessary.

- It trained engineers and their technical staff to understand the organizing process and the work of the COs and so reorientated their attitudes and procedures to promote farmers' participation, especially the processes of coordination of technical and institutional activities.

- It mounted an information and education programme on the participatory approach for all personnel in areas covered by the programme.

NIA encountered a number of problems, among which were the following:

- Initial resistance of planning and construction engineers to share decision making with farmers on various activities such as location of canals and structures and control of construction costs. Many engineers felt that farmers' participation would cause delays and make the work more difficult. As the programme progressed, however, they found that while extra effort and time was spent in establishing coordination processes with farmers, once these were established, work became easier and faster.

- Displacement of NIA personnel due to take over of operation and maintenance by irrigation associations of pilot areas in national irrigation systems. These personnel are ditchtenders and watermasters employed by NIA for maintaining the system, distributing water, and collecting irrigation fees. With regard to this problem, NIA has adopted a policy to transfer these personnel to other types of work for which they can be trained or, if this is not possible, to give them special separation pay.

- Setting of appropriate compensation rates for COs and their supervisors. To secure qualified personnel for the programme, NIA hired these personnel on a contract basis, renewable yearly at total compensation rates (including fringe benefits) comparable to those recieved by regular NIA personnel doing comparable work. Extreme difficulty was met in getting this confirmed by the Ministry of the Budget which insisted that the total compensation of contractual personnel including fringe benefits should not exceed 120 percent of the minimum basic pay - a condition which results in a much lower total compensation for contractual personnel.

On the whole, except for some difficulties with the Ministry of the Budget, other government offices and external agencies have been supportive of the participatory approach programme. The Office of the President has exempted the programme from the current ban on hiring of contractual employees. This exemption has made it possible to continue and expand the programme. The World Bank and the Asian Development Bank have incorporated the participatory approach in the NIA communal projects for which they have extended financial assistance. Likewise USAID is promoting it in its programmes in the Bicol River Basin. The Ministry of Agriculture and the

Bureau of Forest Development have also started pilot projects exploring the use of participatory approaches in dealing with farmers.

3. ASSESSMENT OF RESULTS ACHIEVED

The participatory approach that NIA has employed in its communal irrigation programme and which is now being expanded to its national systems has yielded a number of favourable results. In the communal projects these are as follows:

i. Ready acceptance by farmers of the completed physical facilities and their financial obligations. Projects completed prior to the programme were usually accepted only reluctantly by the irrigation associations for operation and maintenance, often because they disagreed with the costs which they had to repay.

ii. Increased counterpart contributions from farmers. In 1982, the total counterpart contribution by farmers in projects covered by the participatory approach programme totalled ₱2.7 million. This increased to ₱4.9 million in 1983. Prior to that, counterpart contributions were almost negligible.

iii. Improved maintenance of canals and higher irrigation fee contributions. This has been observed in the communal systems which have completed their systems management workshops. No data have yet been obtained on better equity of water distribution increases in irrigated area and increases in production.

iv. Increased awareness and understanding by engineers and other technical staff of the institutional factors that affect irrigation development.

In the pilot areas of national irrigation systems the following have been observed:

- No removal of farm ditches by farmers after construction by the NIA. In previous cases, in projects where farmers did not participate in locating the farm-level facilities, many complaints on farm ditch locations were received and the farmers eventually removed those ditches.

- Prior to the programme, NIA had been asking farmers to assume O&M responsibilities after the turnout level but the farmers did not assume such responsibilities. In contrast, in areas covered by the programme it was the farmers that asked and actively negotiated with NIA to turn over to them the O&M for portions of the irrigation system covered by their irrigation associations under mutually agreed contractual arrangements.

- In areas where irrigation associations have taken over O&M and irrigation fee collections the canal maintenance has improved, irrigation fee collections have increased and NIA expenses for O&M have decreased, thus enabling NIA to fully cover those expenses with its share of the collections. Canals are cleaner. There is no damage from wallowing water buffaloes.

  Some difficulties have been experienced in remittance of irrigation fee collections from the association to the NIA but these are being remedied.

- Improved relations between NIA and the farmers and more awareness and understanding by NIA technical staff of institutional development issues in irrigation.

- Only one irrigation association has recently completed a systems management workshop and no data are yet available on improvement in equity of water distribution, and increases in irrigated area and crop production.

4. EVALUATION

Many factors contributed to the increased farmers' involvement in the communal irrigation projects and pilot national systems in the NIA. Among these are: (i) the participatory processes employed, (ii) support of the programme from the highest level of management; (iii) assistance from external agencies; and (iv) the gradual development of the programme through a learning process.

The desirability of farmers' involvement had long been recognized by many of the NIA even prior to the start of the participatory pilot projects. Little, however, had been achieved towards real farmers' involvement because no process had been developed for generating such organized involvement. The employment of the participatory approach, a deliberately planned action to develop the capability of formal groups for interacting with NIA

in planning and construction and for assuming O&M responsibilities afterwards, was missing in the NIA. The development of the process, its testing, improvement and eventual expansion was made possible by dedicated young people eager to do farmers' organizing work and especially trained for that purpose.

The programme had the support of the highest level of NIA management. The pilot stages and initial expansion was directed personally by an Assistant Administrator who had full support from the NIA Administrator. This enabled flexibility and prompt action in developing policies and processes needed for fostering farmers' participation. NIA top management recognized the importance of the programme for the overall improvement of irrigation systems operation. More urgent were problems of non-acceptance by farmers of communal systems constructed or improved by NIA and the wide gap between the highest costs of operation and maintenance in national systems and the low collection of irrigation fees for meeting those costs. Apart from the development of self-reliance and farmer capacity for organization as requirements for rural progress, NIA needed the programme in the light of its own irrigation systems and financial management situations. Given the support of top management and the recognition of the NIA problems the programme became generally accepted at all levels in the organization.

External agencies helped greatly in developing and expanding the programme. The Communal Irrigation Committee (CIC) helped greatly because no adequate internal capability for interdisciplinary diagnosis of problems and design of solutions and processes could be found in the NIA at the start of the programme. It was the understanding in the CIC that this interdisciplinary capability would be enhanced within the NIA and workshops were organized to do this. Funding and staff assistance from the Ford Foundation produced studies on existing communal systems, formulation of socio-technical profiles, and documentation of work activities in selected irrigation systems. It also produced various training programmes for community organizers, CO supervisors, profile writers, irrigation engineers and various technical staff. The adoption of the participatory approach by the World Bank-assisted Communal Irrigation Development Project further enhanced the application of the participatory approach in the NIA. At the end of 1983, it had been adopted as the standard procedure in all NIA communal irrigation projects and was being expanded to the national irrigation systems.

The gradual development of the programme helped ensure that the organizing, coordination and training processes were fully tested and that experienced staff and adequately trained personnel were available when the programme was expanded. It took four years of pilot project activities before the programme was expanded to the regional level and another three years before it became institutionalized in communal irrigation development. Within that period NIA gradually attained national capability for running the programme. Starting from identification of problems in the field, it developed processes and solutions for these problems, tested and improved these processes and used the improved processes for training personnel who were fielded to undertake the organizing programme. Periodic review and planning workshops involving both technical staff and community organizers were instituted to improve the processes further. The personnel who gained valuable experience became core groups that were utilized to train additional personnel for expanding the programme.

The NIA efforts to enhance involvement of farmers in irrigation development have brought beneficial results in some respects but not from the standpoint of improved irrigation efficiency. The systems management training for irrigation associations is fairly recent and the irrigation associations need time to improve on their systems management. Furthermore, NIA has to assist the associations in developing a monitoring system that they can use for evaluating their systems management. Moreover, in the large national systems where the goal envisioned is to have NIA operate and maintain the major canals while the irrigation associations operate and maintain zones or sectors of about 250 to 400 ha, the necessary interfacing of NIA and association operations is still to be developed. Until this is worked out, the schemes developed so far would be used only in the smaller national systems not exceeding 2000 ha and would not be expanded to cover the larger ones fully.

The processes that NIA has employed for enhancing farmers' participation may or may not be successful if applied in other countries. There are, however, some lessons from the Philippine experience which may be helpful, namely:

i. The choice of the organizing process is crucial. The organ-

izing strategy should be designed around activities meaningful to the farmers. Opportunities should be made available for farmers to participate in problem solving and decision making about issues that affect the benefits that they derive from irrigation development. The Philippine experience indicates that farmers participate when given the opportunities and when such participation will yield benefits they can perceive.

ii. The organizing process should be linked with the technical processes of planning and construction and with operation and maintenance of the irrigation system as the ultimate goal. Tight coordination between the organizing work and the technical activities is extremely important. Thus it is advisable that both be undertaken by the same agency.

iii. As organizing effective farmers' participation takes time, it should start well before the construction of a project. It should be carried through to the operation and maintenance stage as organizational changes are needed when an association progresses from construction to O&M.

iv. For an agency to be able to promote farmers' participation, it must be capable of responding positively to such participation. Where there is no capability, it has to be developed. This will necessitate hiring of specially trained personnel and amending policies and procedures that inhibit participation. Developing agency capacity takes time. It is best to adopt a learning process approach.

v. Strong support from the highest level of the agency is necessary. Introduction of farmers' participation in irrigation development requires innovative action where such participation has not been allowed before. Problems may arise that can be resolved only at the highest level of the agency.

CHINA'S RESPONSIBILITY SYSTEM AND FARMER PARTICIPATION IN WATER MANAGEMENT: THE EXAMPLE OF YUCHENG COUNTY, SHANDONG

by

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The Huang-Huai-Hai (North China) Plain plays a strategic role in China, both geographically and economically. Home to over 200 million people, it stretches from Beijing, the nation's capital, in the north, to the basin of the Chang Jiang (Yangtze River), China's largest waterway, in the south. Flowing west to east through the plain, forming an artificial watershed perched on a bed several metres above the surrounding land, is China's second longest and the world's most heavily silt-laden river, the Huang He (Yellow River).

With its 300 000 km^2, the Hunag-Huai-Hai Plain occupies about one-third of China's flatlands. Its cultivated area of 18 million ha is one-sixth of the national total. Grain production, especially that of wheat, increased markedly on the plain in the early 1970s with the rapid expansion in irrigated area following the drilling of more than one million tubewells and increases in diversions from the Chang Jiang and Huang He. Total grain output, 23.8 million tonnes in 1980, is now about one-sixth of the national total.

Its flat topography, alluvial soil and frequent sunshine provide the plain with many of the ingredients of a farm production which is well above average. Nonetheless, chronic problems of drought, flooding and salinization have prevented the plain being fully developed. Finding solutions to these problems has high priority in China's modernization programme.

Yucheng County is situated in the middle of the Huang-Huai-Hai Plain. Its climate, hydrology, natural disasters and economic conditions are all representative of the plain. Its geomorphological and hydrogeological conditions, as well as its soil chemistry, are representative of the alluvial plains which comprise one-third of the Huang-Huai-Hai Plain.

Yucheng is one of nine counties which has received financial assistance from the World Bank for the control of salinization. It contains an experimental area, set up in 1967 in a marshy lowland by the Chinese Academy of Sciences and related units to study comprehensive control measures for the prevention of drought, flooding and salinization. These measures have been successful. After 15 years, the saline area of the emperimental area fell from 7300 to 1450 ha. Annual grain yields rose from 1.4 t/ha to 4.8 t/ha. In 1983 the Chinese Academy of Sciences set up an experimental station within the experimental area to carry out advanced research on a number of hydrological and agronomic topics.

In recent years, especially since a major shift in economic strategy at the Third Plenum of December 1978, a number of economic and institutional reforms has been carried out in China. Prominent among these are the various production responsibility systems (PRS - shengchan zeren zhi) which have shifted the primary responsibility for field operations and income distribution from the collective to individual households. Responsibility systems in water management have lagged behind somewhat. In the past, the farmers had too little responsibility for water management; now, perhaps, they have too much in some areas, with too little support. Other areas, especially the control of surface flows, may have to remain under more direct, albeit more responsive, state control.

1. YUCHENG COUNTY'S NATURAL CONDITIONS

Yucheng County is situated north of the Huang He in northwest Shandong Province. Its topography slopes from southwest to northeast, with an average gradient of 1:18 000 to 1: 10 000 and an elevation of 17.6-26.1 m above the Huang Hai (Yellow Sea), on the alluvial plain of the lower Huang He. It extends for 58 km from north to south and 33 km from east to west, encompassing a total area of 998 km^2. The county (see Fig. 1) has a total of 19 communes (townships), 1050 natural villages, 952 production brigades (roughly equivalent to natural villages), 409 900 people, and a cultivated area, according to a 1979 soil survey, of about 56 000 ha, 55 percent of the total land surface.

Yucheng has a semi-humid monsoonal climate, with drought and wind in the spring and early summer followed by a hot rainy season. Its frost-free period is 200 days; its average temperature, 13.1 °C. There are 2639.7 hours of sunlight each year.

Mean precipitation is 616 mm, well below the average evaporation of 1379.5 mm. Precipitation is seasonally concentrated, with 76.4 percent falling in the four months from June to September, but only 12 percent from March through May. The latter can satisfy about 30-40 percent of the water requirements of winter wheat during those months; the remainder must be supplied through irrigation. The amount of precipitation also varies greatly from year to year, ranging in the available records

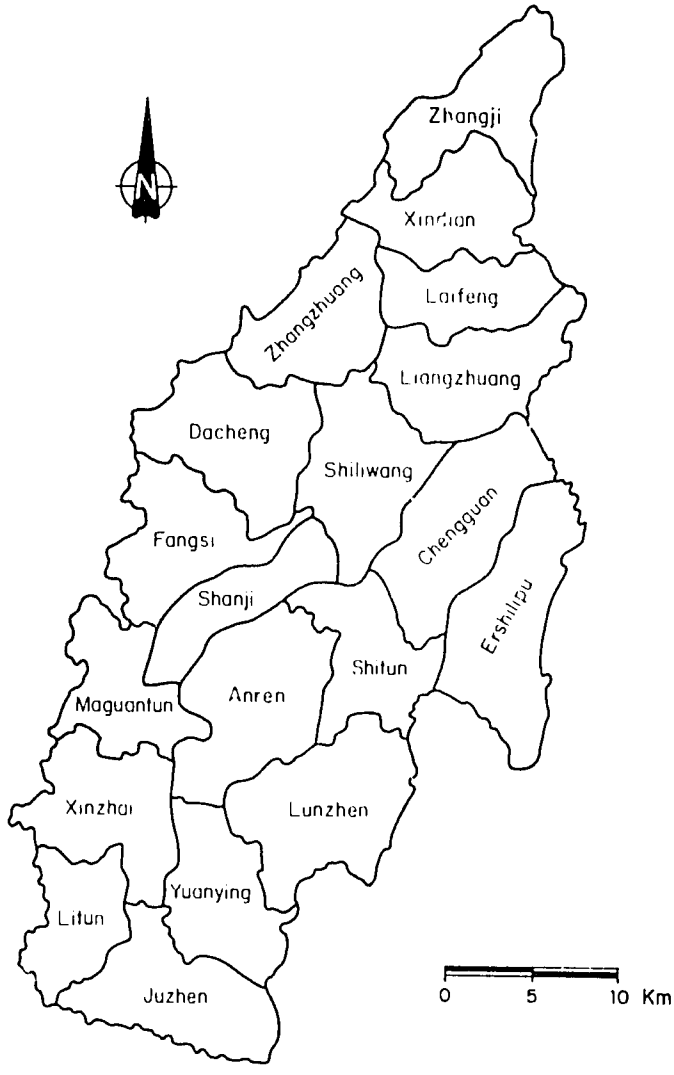

Fig. 1 Administrative map of Yucheng County (by Commune)

(1950-80) from 1144.44 mm in 1964 to 239.0 mm in 1968, with a high incidence of dry years (36 percent).

Yucheng's soil is formed from the alluvium of the Huang He. All the soil parent material is saline to some degree. In the absence of proper drainage, capillary action from the elevated water table carries the salts in the groundwater and soil into the layer of cultivation, where they remain after the water evaporates. Despite the success in controlling salinization in the experimental area, the area of saline soil in Yucheng County has tended to increase over time. In 1980, 19 250 ha of land were saline.

2. YUCHENG'S WATER SYSTEM

For more than three decades, Yucheng County has improved its water system through dredging, widening and deepening its natural channels, digging new irrigation and drainage channels and drilling wells. Together these form the present water system (see Fig. 2).

Local river runoff and the diversion from the Huang He provide the two main sources of surface water.

The Tuhai River is the main natural channel crossing the county. It has 25 tributaries with a total length of 393

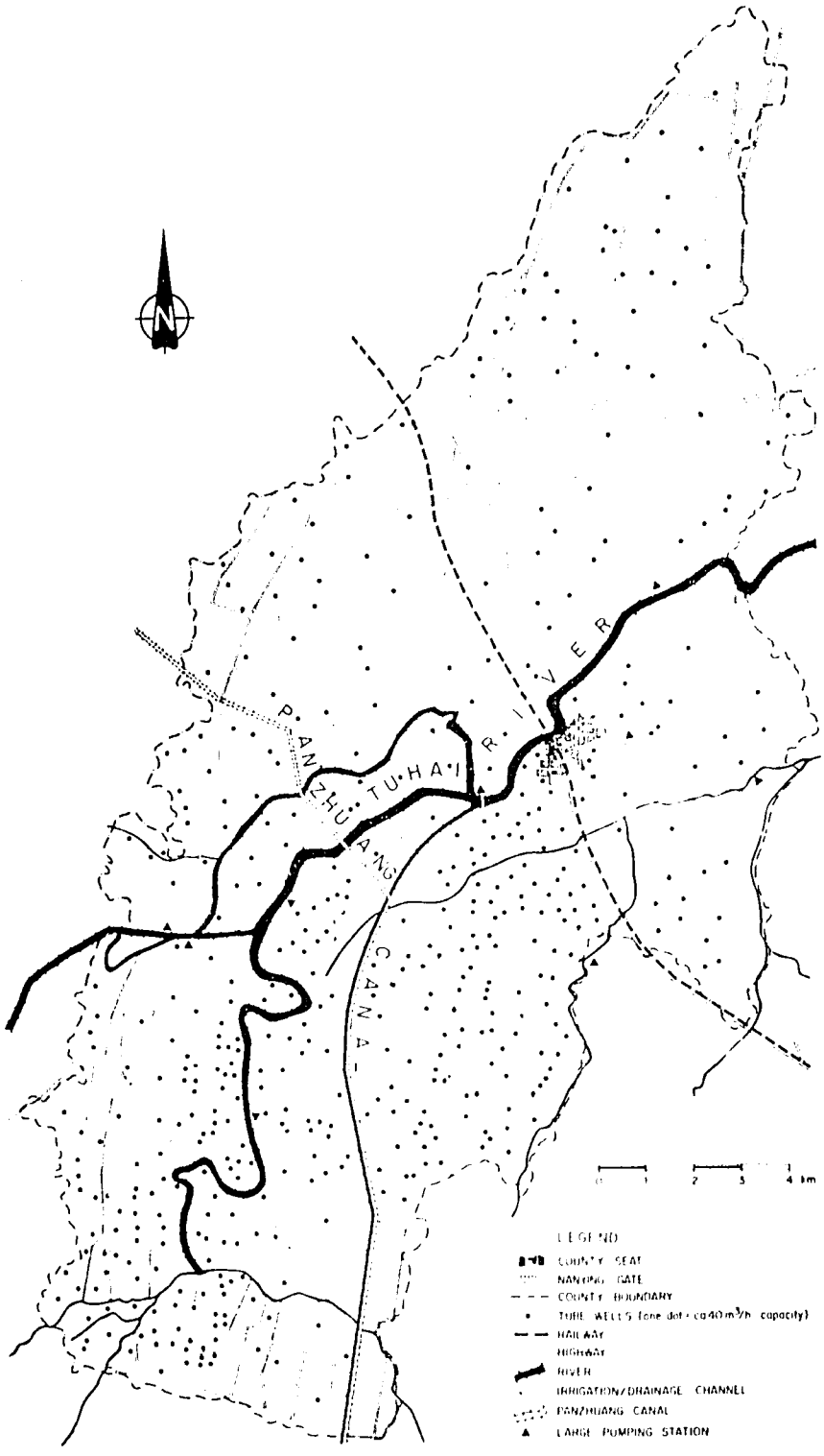

Fig. 2 Yucheng County's water system

km. Below the tributaries are 1286 branch, sub-branch and farm channels with a total length of 1901 km.

About 0.06 km^3/annum of the river runoff is produced withi the county, with the remaining 0.35-0.40 km^3 /annum originating elsewhere. Since nearly all the runoff in the rivers comes from the flood season, the storage capacity in the county is limited to 0.027 km^3, with the remainder flowing to the lower reaches or consumed in evaporation or seepage.

The Panzhuang Huang He Diversion Channel is the main artery for the direct diversion of surface flows from the Huang He into Yucheng County. With a total length of 100 km, 36 km in Yucheng, it flows through Jihe, Yucheng and Pigyuan counties. Within Yucheng it feeds four distributaries with a total length of 27 km and a canal system with 104 ancillary works and a total length of 106.3 km. At present, there are 14 diversion gates, 108 offtake channels and 265 structures on the Panzhuang system. After satisfying the water use needs of a gravity-fed irrigated area of 1300-2000 ha, the remainder flows into drainage channels at the branch level and above.

The other line of conveyance consists of the tail waters of Huang He diversions from outside Yucheng and the surface runoff during the wet period. This passes through the Nanying Gate on the Tuhai River and flows directly into drainage channels at the branch level and above. The main channels store water for half a year or more, and the branch ditches for two or more months.

Because the drainage channels are 3-5 m below the surface, all of them require pumping for their water to be used for irrigation. There are 180 fixed pumping stations in the county with an installed capacity of 2345 kW. Nine of them are relatively large. There are 2635 sets of mobile water lifting machinery, with a total of 22 895 kW.

The diversion from the Huang He includes 0.06 km^3/annum drawn directly from the Huang He and about 0.3 km^3/annum of tail waters which flow in from upstream counties. Of the latter, only 0.004 km can be stored for later use.

There are no large reservoirs or lakes within Yucheng County, and only 2935 scattered ponds with a total storage capacity of 0.007 km^3. The county's surface water system, consisting mainly of rivers, canals and ditches, with a density of 2.47 km/km^2, is typical of the Huang-Huai-Hai Plain.

Thus the total amount of surface water utilized is 0.127 km^3.

The groundwater system is composed of several broad, deep aquifers and a dense network of tubewells. Groundwater storage conditions in Yucheng County are extremely favourable, with the depth of Quaternary deposits reaching 400 m or more. The water-bearing strata consist principally of fine or medium sand and silt. There are three aquifers within 150 m of the surface, each several metres to several dozen metres thick. An additional three to five confined aquifers lie below 200 m. The average depth of the groundwater surface is 2-4 m.

Recharge comes from three main sources: 0.1167 km^3/annum from seepage from precipitation; 0.0569 km^3/annum from seepage from the Huang He diversion channels; and 0.0371 km^3/annum as recharge from the canal system and field irrigation. Subtracting the portion which is consumed in evaporation and that which is too saline for use in irrigation (exceeding 3000-5000 ppm), leaves a figure of 0.1177 km^3/annum which can be abstracted.

Groundwater has become an increasingly important source of irrigation water. Of the 3651 electrically or diesel-powered tubewells, 85 percent, or 3090, are fully equipped, with a total motive power of 26 638 kW. Nonetheless, their rate of utilization is relatively low. They only withdraw 0.03 km^3/annum, just 20 percent of the resource. This does not count the innumerable earthen wells and wells with hand pumps which have been dug by the farmers themselves.

In sum, the usable resource from both surface and groundwater in Yucheng County is 0.157 km^3/annum, 81 percent of it below the surface. Of the 41 540 ha currently effectively irrigated, 22 000-22 700 ha are irrigated by surface water, 12 500 by wells, and the remainder by both. A large potential remains untapped.

3. IRRIGATION PRACTICES

As shown in Figure 3, the area under irrigation in Yucheng has increased enormously since the founding of the People's Republic of China in 1949. The expansion was particularly rapid after 1971, with the formation of relatively complete irrigation systems, especially the increased use of tubewells, and the revival of diversions from the Huang He in 1975. With

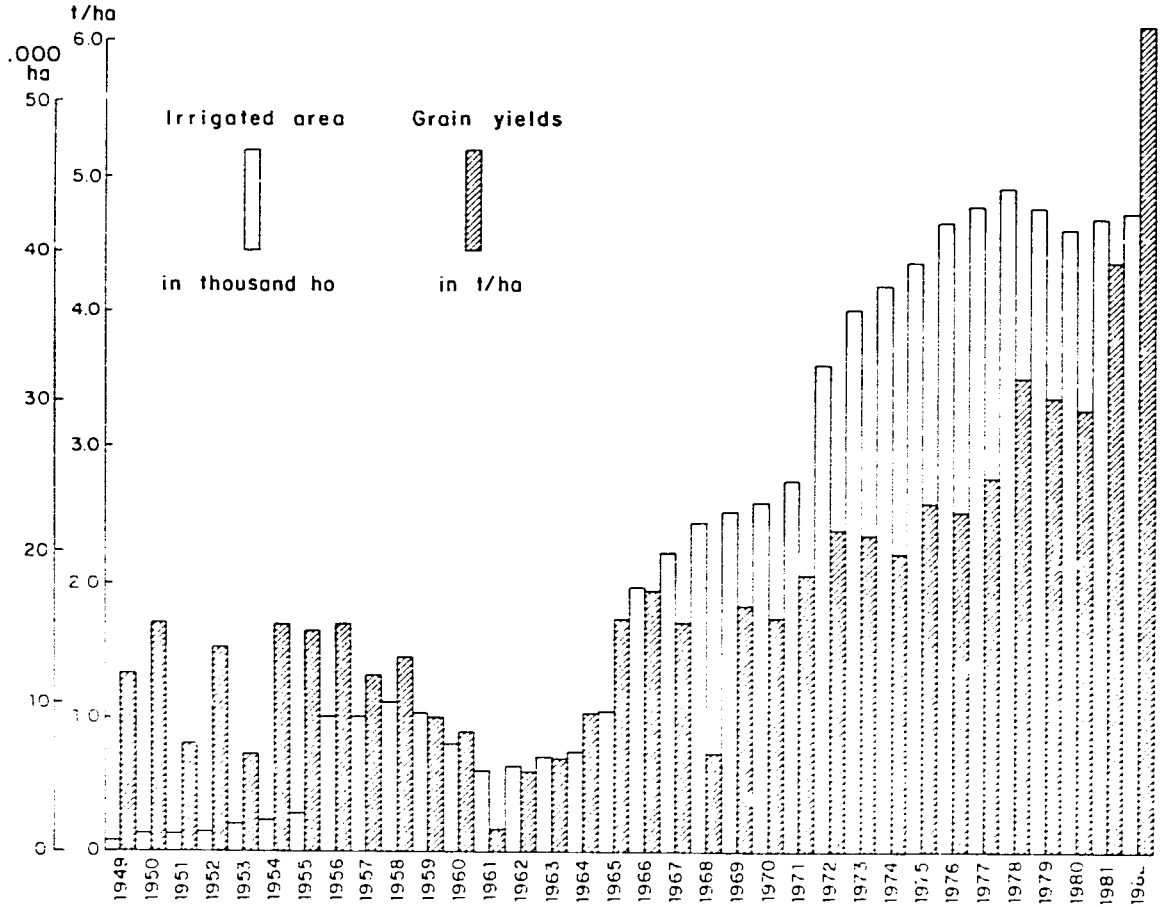

Fig. 3 Yucheng's irrigated area and grain yields

more than 360 times as much land now under irrigation as in 1949, increases in Yucheng's agricultural production have depended heavily upon improvements in water supply.

The Huang He provides a secure supply of water in the spring months to the areas serviced both directly by the Huang He through the Panzhuang Canal and indirectly from the tail waters of upstream diversion. The main grain crop, wheat, requires up to six irrigations - during autumn sowing, during the winter, when the wheat is "getting out of bed" (after regreening and before jointing), and during earing, milking and yellowing.

There are very few measuring devices in the irrigation system, and only three hydrological stations on the main canal. There is therefore no way for the Panzhuang Canal authorities to control water use below the main canal. Except for a few individual places which use buried pipes, the county relies on flood irrigation, with a high usage of 1500-1800 m^3/ha per irrigation.

At present, the rate of utilization of tubewells in the county is less than one-third their capacity. Wherever possible, farmers prefer to use surface water rather than groundwater. An impressionistic list of the reasons for this, in decreasing order of importance, is the following:

i. The high cost of diesel, on which most wells rely. Although the China Fuel Company allocates each person 3 litres of diesel a year at a relatively low price of 0.38 yuan/litre ($0.19), this can satisfy only one-third of water use demands. The remainder must be purchased through informal channels at a price of roughly 1.04 yuan/litre ($0.50), nearly three times as much. It costs 65-90 yuan/ha more per irrigation (not including machinery maintenance) to use wells than to draw from the river. The diesel allocation for Yucheng County has been cut from 8226 tonnes in 1976 to 4750 tonnes in 1983. Because of the escalating cost of diesel and its diminishing supply, more and more farmers are abandoning their tubewells for river water where possible and, where not, for hand pump wells.

ii. One-third of the more than 5000 tubewells dug in Yucheng are unusable, either because they were improperly dug or because they have not been properly maintained. In addition, many were dug more than a decade ago, and are nearing the end of their usable life.

iii. Well irrigation requires a higher expenditure of labour than does watering from surface sources. The farmers feel it is too much trouble to use wells when other sources are available.

iv. Maintenance is too complex, and most farmers have had little training in areas such as cleaning wells or repairing machinery.

v. The groundwater is colder than the surface water during much of the irrigation season. Also, the farmers do not trust the water unless they can see it. They prefer the water of the Huang He, with its high silt and organic content.

Well irrigation is therefore found mainly in saline areas with a very high water table, where there is no surface water for irrigation, or where the supply of surface water is unreliable. Those who use wells exclusively also engage in flood irrigation. Although they use less water than those who rely on surface sources, they nonetheless apply as much as 900-1050 m /ha or more.

In order to rationalize the use of different sources of water, the county has divided Yucheng into six different water use zones. These are depicted, with approximate boundaries, in Figure 4.

4. DRAINAGE

Irrigation is not a problem in Yucheng County. Drainage is. With its flat topography, Yucheng's groundwater movement is almost entirely vertical, especially in the lowlands. Since precipitation is seasonally concentrated as well, the wet season brings the danger of flooding and secondary salinization.

At the beginning of the 1950s, the county had only a few natural drainage channels: the Tunai, Wei, Chaoniu, and Tuma rivers. These were all less than 30 m wide and 3 m deep. There were no drainage ditches or culverts, and the farmers themselves had to raise the funds to build even simple bridges to cross the channels. The rivers were choked with weeds, seriously impeding drainage. Yucheng lived under the continual threat of flooding. In the two relatively large floods of 1937 and 1961, more than 60 000 ha, about

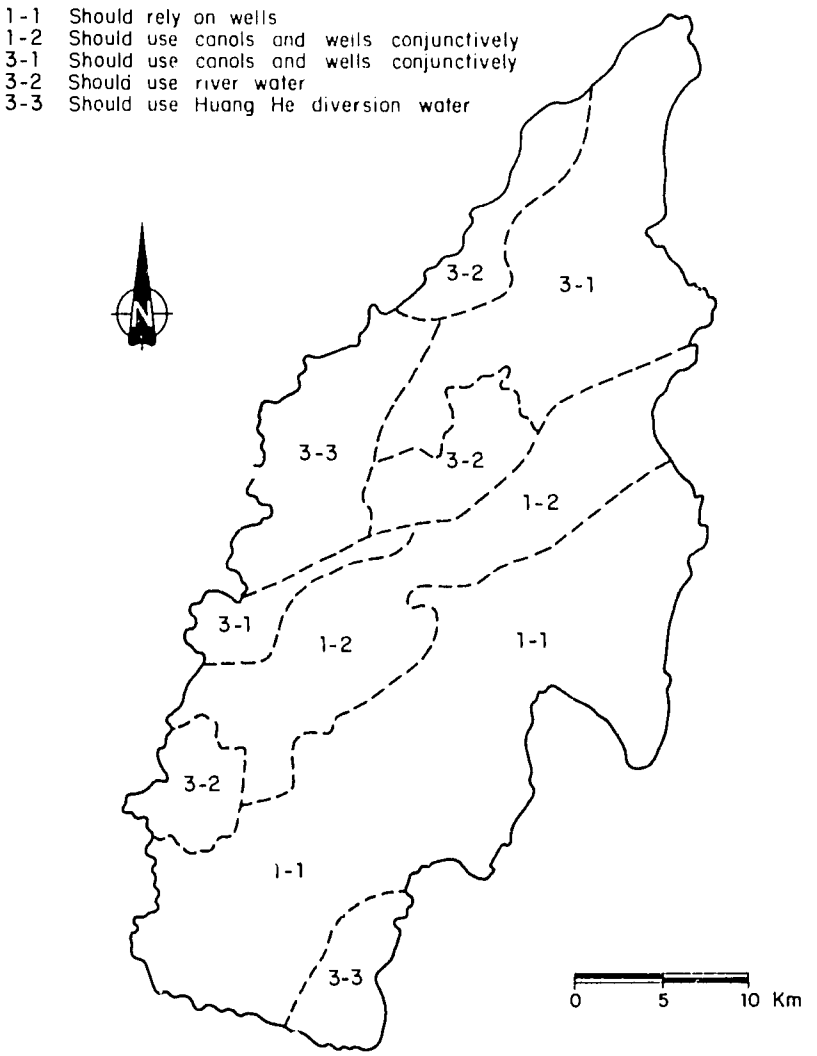

Fig. 4 Yucheng County's water use zones

90 percent of the county's usable land, were submerged.

The drainage situation was aggravated in 1958 whe Yucheng began to divert and store irrigation water from the Huang He. The county soon found itself faced with a rise in the water table. After the heavy flood of 1961, neither the surface nor the groundwater could be drained promptly. The saline area increased from 8000 to 23 000 ha and virtually all the grain crop was lost.

Thereafter, the people of Yucheng refocused their full attention on drainage works, especially surface, but in so doing they not only failed to complete their original irrigation systems but even destroyed some of the existing facilities. When a major drought came in 1968, both the rivers and the wells dried up and there was no water for irrigation. Grain output collapsed once again. The people of Yucheng absorbed this lesson and adopted a more balanced approach. They took the first steps towards setting up a system which handles both irrigation and drainage and maintains the water table below the critical depth.

Drainage conditions have been greatly improved. The basic measure adopted has been to drain with both canals and wells and to use wells for both irri-

gation and drainage. Drainage channels have been used mainly to draw off water which has accumulated on the surface, while wells have served mainly to raise and lower the water table.

In practice, the Tuhai River is a main drainage channel. It has been widened to 300 m, deepened to 4-5 m, and straightened so that it will allow a flow of 614 m^3/s.

At present, 47 300 ha are served by a two-level (main, branch) drainage system: 28 100 ha by a three-level system (including sub-branch); and 18 500 by a four-level system which begins at the farm level. The remaining 7100 ha have no drainage facilities.

5. WATER MANAGEMENT ORGANIZATION

Figure 5 is an organizational chart of the water management organizations affecting Yucheng County. Units connected by solid lines are related hierarchically on an administrative basis, with some professional relationships. The distinguishing feature of an administrative relationship is the authority of the higher unit to transfer or change the administrative staff of the lower one. Units connected by dotted lines deal with each other on an exclusively professional basis. The utilization and allocation of water are carried out by the professional departments under the leadership of the governmental departments

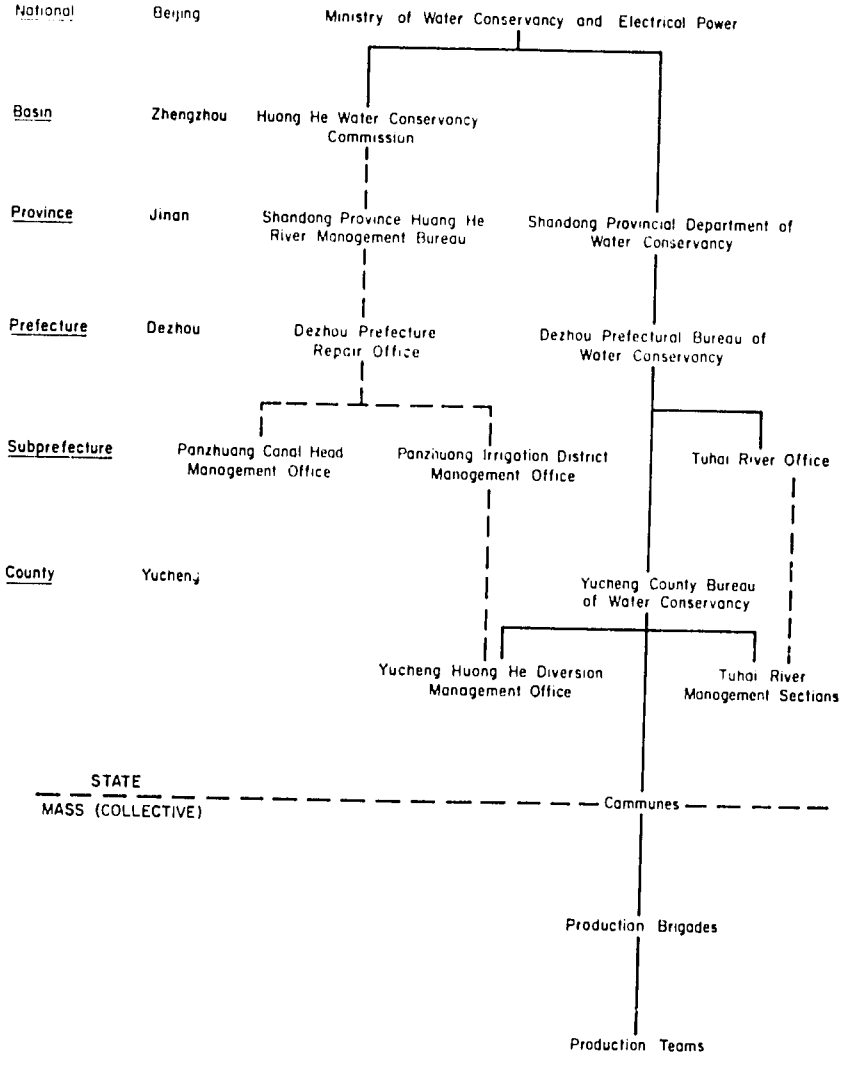

Fig. 5 Water management organization chart

at the same level. For example, the amounts and times of water release by each county within the Panzhuang Irrigation District are determined by the prefectural government and implemented by the prefectural water conservancy bureau. The management organization does not have the authority to supply state water without higher authorization. Similarly, the water allocated to the communes in Yucheng County is directed by the county, with the county water conservancy bureau allocating the water. Units which belong to the different management systems are interconnected in their work and when problems arise they resolve them through mutual discussion. Nonetheless, water management is made quite complex by the division of authority.

The management organizations operating within Yucheng County are the following:

The Panzhuang Irrigation District Management Office is responsible for measuring the flow and silt load in the main channel, managing the primary, secondary and tertiary silt stilling ponds and carrying out professional leadership over the Huang He diversion offices of each county. It also proposed the opening and closing times of the gates at the canal head and deliberates with the canal head management office, which is located along the bank of the Huang He in Jihe County. The latter is responsible for the project within 100 m of the canal head, the maintenance and repair of the canal head, and making the final determination on the opening and closing times of the canal headworks.

The Yucheng County Huang He Diversion Management Office is under the joint leadership of the Yucheng County Water Control Bureau and the Panzhuang Irrigation District Management Office. This office is responsible for the upkeep and repair of the embankments, including planting trees and grasses on them, and for the distribution of water into the sub-main canals. Once the water enters these canals, its management becomes the responsibility of the communes where the canals are located.

The County Water Control Bureau, besides providing leadership to the Yucheng County Huang He Diversion Management Office, is also responsible for managing the engineering structures on the Tuhai River and its tributaries. Because the Tuhai River flows through several counties, the large Nanying Gate is managed separately by a prefectural agency and by management sections under the county water control bureau. The former is empowered to open and close the gate, while the latter must have the approval of the prefectural water conservancy bureau to use water. Concurrently, the county water control bureau is responsible for providing financial assistance for small-scale on-farm water works such as well digging and ancillary field works.

All the above are state water management organizations. The following are the mass management organizations.

The Commune. The commune has an intermediary role between the state and lower levels of the collective. Most communes have one full-time water control functionary. Some have water control stations which receive assignments from higher level management organizations for tasks such as organizing labour or forming embankment protection teams. They also organize the management for the various levels of canal systems at and below the branch level and resolve disputes over water use. Communes with suitable conditions also set up technical contingents such as well-drilling teams or construction crews.

The (Production) Brigade. This level receives assignments from the commune. In general, one brigade leader is in charge of water control and is responsible for organizing the production teams and the farmers to participate in protecting the embankments, digging wells, and maintaining and cleaning channels within the brigade.

The (Production) Team. This level directly appoints people to be specifically responsible for carrying out the assignments allocated by the brigade, such as supplying name lists of construction labour and embankment protection personnel. The team directs the farmers in tasks such as irrigating the land and digging brick or earthen wells.

6. FARMER PARTICIPATION IN WATER CONTROL BEFORE THE RESPONSIBILITY SYSTEM

The farmers have sought to cast off their poverty for more than three decades by participating in water control construction. Although project facilities at the main and branch levels have been built with state investment (including funds, design and critical materials), the labour has been provided by the farmers.

In the early 1950s, when the state was in a period of economic recovery, the farmers received no construction wages

from the state and had to bring their own food grain to the work site. Once the economy improved, the government provided some subsidies, but they were limited to about 0.30-0.40 yuan ($0.15-0.19) per day. The farmers relied mainly on mechanisms such as the awarding of work points recorded in their production teams to compensate them for their labour. This dual remuneration method continued from about 1956 until the introduction of the rural production responsibility system (PRS) in 1981.

Projects at the branch canal and below were planned and designed by state management organizations, while the construction crews were organized by the communes, brigades and teams. The operation and maintenance (cleaning, tree planting) and management of small-scale facilities have generally been the responsibility of the mass organizations.

The wells were mostly built by the production brigades. When they felt the need for a well, the farmers first discussed where to locate it, how to provide the money, and how to drill it. The brigade leader would then make the final decision and would organize the well digging. The brigade would hire a county or commune crew to dig a relatively deep tubewell. While the labour and operating expenditures were borne by the farmers through their production team or brigade, the state provided a certain subsidy (per well, independent of depth). Once the well was dug, the production team brigade arranged for its operation and management.

During this period, farmer participation in water construction had the following general characteristics:

i. The state played a strong role in organizing and coordinating the farmers' efforts.

ii. In principle, the farmers developed projects and managed water resources within the bounds of their own production activities.

iii. Because the farmers had limited economic and technical capacities, the state had to give technical, material and financial assistance both to small-scale on-farm projects and to well digging. But as they were under the control of a number of managment organizations, the farmers tended to lack initiative and independence.

iv. The level of management was low. The farmers lacked sufficient scientific knowledge of optimal water applications. In addition, the watercourse ancillary projects were left uncompleted. The result was a rather serious waste of water. The farmers also did not understand the importance of using the groundwater and the surface water rationally and conjunctively. Instead, they often used whatever source was the most convenient, usually surface water, with no regard for the consequences to others.

7. THE PRODUCTION RESPONSIBILITY SYSTEM

Over the past several decades, China's rural areas have been the scene of a number of major and well-publicized institutional reforms. Perhaps the most profound has been the switch to a production responsibility system in the past few years. The previous system, where field operations and income distribution were carried out collectively at the production team or brigade level, had led to a relatively egalitarian income distribution, with a lot of free riding - "eating from a common pot" and "drinking from a common pot". Farmers had little incentive to work hard or manage collective resources economically.

In addition, higher levels interfered excessively in determining the type of economic activities which could be carried out. For many years, China has had an agricultural policy of "taking grain as the key link, developing a well-rounded economy, acting in accordance with local conditions, and centralizing where appropriate". Although this policy is unexceptionable as stated, in the actual process of implementation, many areas, including Yucheng, concentrated on field crops, especially grain. In the process, they neglected the other aspects of a well-rounded rural economy. In China, a complete production portfolio normally includes the "five activities": of agriculture (including grain), forestry, animal husbandry, sidelines and fisheries.

In Yucheng County, grain output and its gross value increased over the period from 1971 to 1979 at an average of 4 percent/annum, while the share of grain in the gross value of the "five activities" ranged between 63 and 72 percent until 1979, when it fell to 57 percent with that year's revival of sideline industries. Unit grain yields increased by 5.4 percent/annum, due to a decline in the grain area. But this grain was produced at a rapidly in-

creasing cost. Net output value of grain only increased at an average of 1.5 percent/annum.

Beginning in 1978, farmers were increasingly allowed more freedom to adjust the relationship between grain and other economic activities. The results were remarkable. The area devoted to grain shrank from 39 560 ha in 1979 to 27 620 ha in 1982, yet grain output increased from 116 900 to 175 500 tonnes.

A hefty boost in grain procurement prices and a somewhat smaller reduction in the prices of manufactured farm inputs in 1979-80 led to a 49 percent jump in net income from grain in 1980, despite an 18.5 percent fall in total output. With the additional income from the cotton, oil-bearing crops and hemp sown on the former grain land, the agricultural economy has flourished in the 1980s. In addition, farmers have supplemented their income by planting economically profitable trees, orchards and forage grasses in conjunction with controlling saline land, and they have developed their animal production. This initial revamping of the rural economy doubled farm incomes in two years.

The latest stage of reform is the production responsibility system, introduced in Yucheng in 1981 and fully implemented in 1982. The PRS has taken a number of forms, but the one which has become the most common in China, and which has been universally adopted in Yucheng County, is the "contracting of output to the household" (Baochan daohu). The results nationwide over the past two years have been striking. Grain output (including tubers and soybeans) increased by 50 million tonnes, from 325 to 375 million tonnes, between 1981 and 1983, despite a slight decrease in the area devoted to grain crops. Results in Yucheng County were even more spectacular: annual grain yields skyrocketed from 3.38 t/ha to well over 6 t/ha, with a considerable decline in the grain area.

Under the PRS, land, the basic material for agricultural production, still belongs to the state, which owns it on behalf of the entire people. Land and small agricultural implements have been divided up among the farmers on a per capita basis for their use in cultivation. If they do not use them to grow crops, they may not retain them.

Similarly, water rights belong to the state and the whole people. When the farmers dig their wells, erect pumping stations or become households specialized in water control, they have rights over only the machinery and other facilities. They do not have absolute water rights.

The farmers' rights and obligations have been spelled out in contracts drawn up with their production teams. These contracts provide absolute figures for produce to be turned over to the state and collective. These figures, which are determined through negotiation, are based upon what can be expected from ordinary rational use of the land. Any remainder belongs entirely to the family which produces it.

The contracting households have a relatively high degree of independence and initiative in their use of labour and in their operations. They can choose crop varieties which suit local natural and market conditions. They can dispose of their surplus produce in any way they want. If they wish to do something other than farming, they can contract as a "specialized household" with their production team, something which was much more difficult to do in the past when nearly all were obligated to do some field labour. Those who work the land now have greater incentive to improve production through purchasing modern inputs and through studying scientific technology. In January 1984 their incentive to invest in the land was heightened with a new policy providing, in general, for contracts to last at least 15 years before renewal.

With the land divided up, the main purpose of the various mass organizations, which are being reorganized as well, has been to organize tasks such as arranging for mechanized ploughing, contracting out tubewells, pumping or diverting irrigation water from rivers and canals, delivering public grain to the state, and drawing up contracts with households. Because they have shed a number of administrative tasks, they can devote more time, labour and materials to areas such as the development of collectively owned enterprises.

With the PRS and the reforms which preceeded it, farmer income has increased markedly in Yucheng County. From Figure 6 it is clear that although there was some increase in farmer incomes in the decades following the founding of the People's Republic of China in 1949, progress was uneven. Sometimes income even fell. After more than 30 years of effort, by 1980, per capita farmer income in Yucheng was a mere 65 yuan per annum, just 1.71 times that of 1965 and 1.63 times that of 1971. The main reason for this increase was a jump in procurement prices in 1979. In 1981, however, per capita farmer

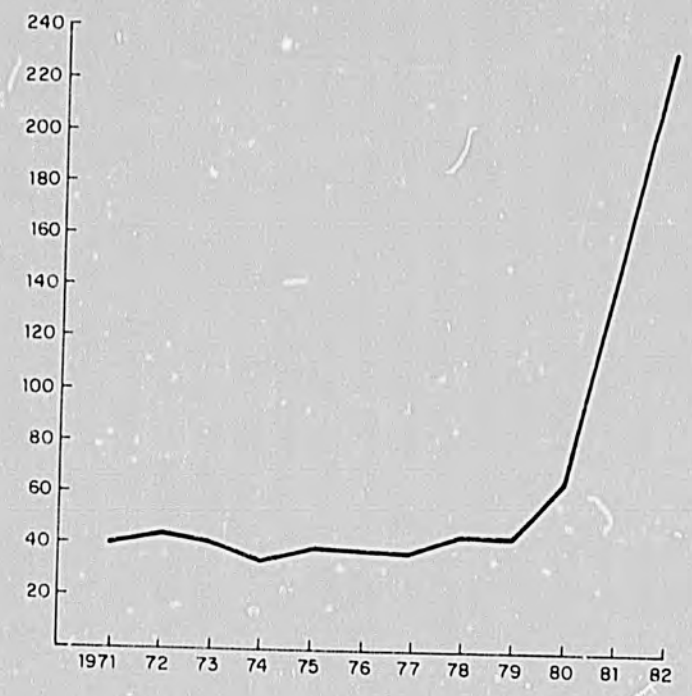

Fig. 6 Per capita income (yuan)

income soared to 151.4 yuan, and in 1982, following the introduction of the PRS, it again rose substantially, to 231 yuan.

With the labour and funds they now have left over - as much as one-third to one-half of their labour power is now freed from field tasks - the farmers have also been able to develop production in other areas, such as household sidelines and animal breeding.

8. THE RESPONSIBILITY SYSTEM IN WATER MANAGEMENT

Responsibility systems are also being set up in water management, but progress is somewhat slower than for production operations. Yucheng County has only just begun to establish responsibility systems in water management.

The type of responsibility systems being instituted differ between state and collective (mass) organizations.

The state management organizations are mostly professional units which have a full-time core staff. In the past, this staff earned fixed wages and had secure employment - they "ate from iron rice bowls". In some cases, shorter term, less specialized labour was drawn from the production teams, especially for tasks such as patrolling the embankments. These mass personnel were paid in work points in their production teams.

Since the production teams no longer distribute incomes, however, the work point system has vanished. With the PRS, the farmers have far greater say over the use of their labour. When the state builds or maintains a large water project, therefore, it can no longer simply requisition labour from the production teams. It must hire it for wages which meet set standards. These must be close to the going wage, or the farmers will not do the work. Yet the state water management bodies are themselves short of funds, and with the recent improvements in the rural economy, the necessary wage has gone up. Many Yucheng farmers who participated as "mass personnel" in water management tasks in the past, notably the embankment guards, have left to tend the land which has been contracted to their families, leaving a number of places without anyone to do this work.

In some cases, a certain amount of unpaid labour (yiwu gong) may be required of the farmers as a part of their contracts. This labour, which may involve as much as 20-40 days per year, is used almost entirely for projects at the commune (watercourse) level or below, however, and is not very common in Yucheng County.

State water management organizations, like most other state-owned economic enterprises, are increasingly required to cover their own expenses. The state will continue to give a certain amount of assistance to units with financial problems, but the total available for these purposes has fallen drastically, and is not likely to increase substantially in the future.

Yucheng's water management departments urgently need to raise their management levels and improve their economic productivity. One way they are actively planning to do this is to institute a responsibility system based on job assignment (gangwei zirenzhi). Each staff member and worker will be responsible for carrying out the clearly specified duties of his or her position. At fixed intervals, performance will be evaluated and he or she will be given differentiated compensations and rewards, based on economic criteria.

Where this system has been installed, it has increased the sense of responsibility of the management organs and their personnel. They have raised the level of water management and, by tying together water management and economics, have made more thorough use of their projects. For example, after Sui County, Hubei Province, instituted a gangwei zirenzhi, irrigation efficiency increased, with average consumption for paddy falling from 11 400 m^3/ha in 1978 to 10 800 m^3/ha in 1982. Power generated at the reservoir increased from 4.56 million kWh to 16.0 million kWh. The county's water management departments also developed fisheries and economic sidelines. Over the past four years, total income from the reservoir alone doubled from 1.03 million yuan to 2.15 million yuan, while net income turned around from a loss of 200 000 yuan to a profit of 460 000 yuan. Output value per capita increased by 89 percent, from 1276 yuan to 2419 yuan, with net profits going from a 246 yuan/capita loss to a 518 yuan/capita gain.

The mass management organizations are also in the process of being reformed. Some places in Yucheng have already done a lot of work; others are just beginning. In this reform, the first step is to set up management organizations at each level, a water management crew at the brigade and a water management person in the production team. Specific individuals are to be made responsible for the commune sector management of irrigation canals and drainage ditches within a state irigation district. These personnel include full-time section chiefs, turnout heads, and farm channel heads. They and the part-time mass management personnel such as water releasers and embankment guards are to be chosen by the beneficiary communes, brigades and teams from among those who are honest workers and are interested in water control.

The mass management organizations must adopt forms which are suited to the local PRS and establish responsibility systems with fixed job assignments, fixed job specifications, fixed quality standards and fixed norms for remuneration and penalties. Productive resources such as land are made available to commune-level personnel, who are on the state payroll, to encourage them to develop economic sidelines as well as to manage water. This reduces the burdens to the state, increases the income of farmer water management personnel, and helps them keep their minds on their work.

Liaoning Province provides two polar examples. In 1982, the 14 embankment management offices in Jin County had a gross income from economic sidelines of 680 yuan per capita, higher than the average income of local farmers. Their personnel were contented and their organization was strong. The embankments were well looked after. On the other hand, the 184 embankment personnel who originally looked after the 160 km long embankment of the Huntai River within the boundaries of Liaoyang County did not engage in economic sidelines and had no guaranteed income, so when their villages adopted the PRS, 174 of them left to contract for some land. The embankment organization disintegrated.

Since Yucheng County has good conditions for developing economic sidelines such as forestry, animal husbandry and fisheries, it should be able to follow in the steps of Jin County in the management of its surface flow facilities.

The management of small pump facilities, primarily tubewells, has its own characteristics. In the past, they were managed by the production teams or brigades. After the PRS, three main forms of management have appeared in China:

i. Where management remains collec-

tive, the production team or brigade hires well operators who assume responsibility for irrigation. It sets water fee standards based upon the amount of fuel consumed, expenditures on machinery maintenance and repair, and the wages of the opertors. These fees are usually to be paid ahead of time by the benefitting farmers.

ii. Where several households contract jointly, a number of farmer households lease or purchase pumping equipment from the production team for their common use on a unified account.

iii. Where single households or individuals contract, this may involve households or individuals leasing pumping equipment from the production team or brigade, providing their own fuel, determining pumping times and expenditures, and watering their own land or that of others. Losses can be quite high, however, when several contractors share the same pumps or wells.

Another form, which sometimes developed as a more efficient successor to the previous one, is for the brigade to contract out equipment and wells to specialized households or individuals, who pay all their expenditures out of water fees.

Nearly all of the tubewells in Yucheng County are being contracted to individuals or households. For example, there are 25 tubewells in one brigade in the experimental area. Of these, the 13 which are still usable have been contracted out. Farmer X of the No. 1 Production Team has contracted for one well with a yield of 100 m^3/h, but a command area of 10 ha. When the farmers need to use water, they turn over 1.25-1.5 kg of diesel fuel and 100 yuan to these contractors. If they cannot provide the diesel, they pay 2.25 yuan/hour.

A nearby brigade with 76 ha of cultivated land and 508 people has 18 tubewells, of which 16 can be used. It has also contracted them all to individuals or families. For example, Farmers J and Z of the No. 2 Production Team have each contracted for a well with a yield of 60 m^3/h and a command of 2.7 and [illegible] ha respectively. If the farmers they serve provide their own diesel, one hour of pumping costs them 1.20 yuan; if they do not, they pay 2.50 yuan.

Because Yucheng County has only just begun to carry out this system of contracting, it is still far from perfect. For example, some problems remain in the areas of fee collection standards, the allocation of expenditures between brigade and contractor, and the selection of contractors.

With the PRS, the farmers have the financial and labour capacity to improve their conditions of production. Among these conditions, the principal items are the building of water control projects and improving soil fertility.

Small-scale water control is mostly done jointly by several households. Without some unified direction, their activities can lead to chaos in the distribution and utilization of water.

For example, one commune along the Tuhai River has already built a large pumping station with a 100 kW diesel engine set and a designed irrigation capacity of nearly 700 ha, but some farmers have stopped using the station's water and have bought their own small diesel engines which they take to the river and its branch and watercourse canals to pump irrigation water from temporary individual pumping sites. These farmers scramble for the water and disputes break out regularly among them. Their planless pumping quickly sucks the river dry and wastes the water source. In addition, the labour and fuel costs are much higher. The big machine can irrigate 2-3.3 ha in an hour with 15 kg of diesel, whereas a small pump takes 1.5-2 kg of diesel to irrigate a mere 0.13 ha.

There is a clear need here for a unifying and coordinating organization to oversee the water control facilities built and used by the farmers. This organization should also coordinate the use of water in irrigation. One commune in the well district has set up an irrigation company which takes specific responsibility for large-scale irrigation tasks. One-third of the land in two other communes south of the Tuhai River is irrigated under a unified organization of the commune and brigades. The savings in fuel, water and labour are quite good.

Well irrigation can be carried out independently, but it is necessary to make sure that the wells are spaced rationally, not too close to each other. Using funds from a World Bank loan as seed money, the county has started a new wave of well drilling, some by the state (county), some by the collective sector, and some, hand pump wells, by the farmers themselves. At present there is no unified planning of the location of these wells. Yet even with the PRS, it will still

be necessary to maintain unified planning and joint water use in order to safeguard the wells and structures and to resolve disputes which break out between farmers over the priority or quanitity of water use.

There is also a continuing need for technical assistance. Some farmers have purchased pumps without knowing how to use or maintain them. Some small projects are of poor quality, have a short life and cannot yield the benefits they should. The farmers have made increasingly urgent requests for technial assistance, but thus far there has been little response. In many other areas of the economy, technical advisory offices and technical guidance stations have had some success, and would probably go a long way towards filling the information gap which the farmers now face.

There has also been a disturbing tendency of late for the farmers to neglect drainage. In part, this is due to the lack of abundant water in recent years. But it is also a consequence of the PRS. When the land was divided up, a certain distance was left on both sides of the drainage channels for safety. Some farmers, however, have encroached on this borderland in order to expand their own cultivated area. In some cases, they have even destroyed some of the drainage facilities, especially those in the fields, because they are concerned about the damage they might cause to their fields. This problem will have to be resolved in a uniform way on the basis of a responsibility system in the water management departments.

The PRS does appear to have brought with it some improvement in water economy. Before the responsibility system, the expenses of well irrigation were all borne collectively by the production teams. In that case no one gave much regard for using water sparingly. After the pump was turned on, they let the water flow uncontrolled over the land and even, on occasion, across the roads. Since the farmers now have to lay out their own money to pay for irrigation, they have reduced their use somewhat, but the irrigation technology, especially flood irrigation, remains relatively wasteful.

Districts which divert surface water, mainly via gravity, still suffer from a serious problem of waste, because their water fees are collected per unit area. When the water management departments begin operating like economic enterprises, however, they will come to depend on water fees for their income and their fee collection methods are likely to become more sensitive to actual usage.

The state has given the farmers an enormous amount of aid in water project construction and operation, both before and since the PRS. The Panzhuang diversion system alone involved an investment of 19 355 000 yuan up to the end of 1981. If the expenditures for annual maintenance, digging wells, subsidies for small-scale on-farm irrigation and other water control works are added to the above, the total investment exceeds 50 million yuan, not including interest. At the same time, the state has also provided a large amount of materials and has organized specialized teams to plan, design and construct projects.

After the PRS was introduced, state factories stepped up their production of small irrigation equipment. In addition, the water management departments, on the basis of building and maintaining the backbone projects, have further supported the farmers in building watercourse projects.

The international community has also helped Yucheng County. The World Bank has provided a low-interest loan of over 30 million yuan, which must be matched by the Chinese government. Of the total, 52 percent is to be used for the control, use and management of water. The money is now being used to dig wells and ditches and to build bridges. Researchers from many foreign organizations, including the United Nations University, the United States Department of Agriculture, the University of Hawaii, and Cornell University, have come to Yucheng County. Yang Dequan, the vice-head of the county, went to the United States by invitation to visit and study.

According to present projections, if the county is to irrigate all of its land and provide water to its industry, people and animals it will require a total of 203.5 million m^3 of water per year. Most of this will have to come from groundwater, especially if the problem of salinization is to be avoided. Nonetheless, it would not be advisable to cut off surface diversions entirely, even if an agreement to do so could be reached with upstream counties. Groundwater supplies are not totally sufficient, and one-third of the groundwater recharge comes from seepage from surface sources. For the time being, however, it may be advisable to reduce the supply from surface sources in order to encourage the use of groundwater. In addition, wells and seepage inter-

ception ditches should be dug alongside the canals to prevent the development of secondary salinization.

The past over-emphasis on construction to the neglect of management led to a number of problems, including the digging of unusable or quickly abandoned wells; the destruction of the regulating gates as a result of disputes over water; the collapse and silting up of some canals without anyone attending to the problem; and a consequent inability to control the amount of water used. These problems persist under the PRS.

One of the main reasons these problems appear is the lack of an irrigation organization with authority. Although there is now a whole set of state management organs, most of them are busy with narrowly specialized tasks of expanding construction, maintenance and repair. None has specific authority over water use and management. It is therefore necessary to define the duties of management organs and strengthen their authority in water management; promulgate water laws and management systems; and provide the management organizations with high-level personnel, so that they will, on the foundation of a gangwei zirenzhi, raise the level of management and adopt modern management methods. The mass management organs must also have their responsibilities clearly defined. They must coordinate with each other, and set up an effective system of rewards and fines.

Most of the farmland in Yucheng consists of border checks over 100 m long. The canals are almost entirely unlined. The upper reaches pay no heed to the lower reaches when they use water. These characteristics waste water and energy, and create a relatively large groundwater recharge, elevating the water table.

One area of reform currently under discussion is a change to advanced irrigation techniques, such as the use of furrows, buried pipes or sprinklers. Experimentation has already begun on these items in Yucheng. Sprinkler irrigation shows some promise, although spring winds make it difficult to use and its fuel consumption is relatively high. None of the county's 80 sprinklers is currently being used. Sprinkler irrigation will probably be concentrated, at least at first, in cotton and peanut growing areas, because these districts are the most deficient in water resources and have uneven land yet the wind effect is relatively small during the crop irrigation period.

9. CONCLUSION

Since 1949, the development of water control in China has guaranteed the development of agriculture. The production responsibility systems adopted in recent years have spurred rural development, and provide the farmers with strong incentives for developing small-scale, on-farm water control facilities. Reforms in water management have not kept pace with those in field production. Some long-standing problems remain, while new ones have arisen, due to the lack of coordinating mechanisms to harmonize the interests of individual farmers and the greater collective. Responsibility systems must be set up in the state management organs, the farmers must be provided with adequate technical assistance and, in Yucheng County, means must be found to discourage the use of surface water and encourage the use of groundwater. It is particularly necessary to address the problem of the inadequate supply of energy for pumping.

FARMERS' ASSOCIATIONS IN THE POCHAMPAD IRRIGATION PROJECT: A CASE STUDY

by

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A tradition of people's participation was well established in India's old irrigation projects. But the large state irrigation projects built in the past century have given the beneficiaries a minor role in irrigation matters. The link between the government and farmers is provided by subordinate government personnel who regulate the flow of water to the canal outlet command (Chak), assess water charges or oversee systems of water distribution at the farm level. Water distribution is not always fair: some receive hardly any water while others over-irrigate. System deficiencies are more widespread than acknowledged. Familiarity with details of systems performance or concern for problems perpetually faced by farmers and field officials leaves much to be desired. The present situation calls for a radical change in approach to irrigation management. Monitoring of field deliveries with full people's participation could bring about a much needed change in the relationship between the creators of irrigation resources and its users.

The Pochampad project in Andhra Pradesh provides one example in India where an administrative strategy for irrigation development and management was developed by government under the aegis of the CAD authority, paying due regard to system performance at the field level with farmers' participation. Irrigation associations (pipe committees) principally set up to assist in irrigation development were gradually involved in irrigation management. This paper discusses how farmers' associations were created, what the outcomes were and presents some implications for the future. The paper is based on a study conducted between 1979 and 1981 on the Pochampad project in Andhra Pradesh with a grant from the Ford Foundation, New Delhi, when the author was working at the Administrative Staff College of India, Hyderabad.[1]

1. BACKGROUND

1.1 Project Area and the People

The Pochampad (Sri Rama Sagar) project derives its name from Pochampad village where the reservoir across the river Godavari is located 200 km north of Hyderabad in the state of Andhra Pradesh. The catchment area spreads over 91 700 km². On completion, the storage capacity of the dam will be 200 tmc while in 1984 it stored 60 tmc. Water for irrigation was first released in 1970 for Kharif (monsoon) irrigation, particularly for paddy, and from then onwards in stages for Kharif and Rabi (winter) irrigation.

The command area is still under development (Fig. 1). In the first phase, to be completed by 1985-86, the project will irrigate 228 000 ha; on completion a total area of 644 000 ha will be irrigated in five districts of Andhra Pradesh.[2] The water distribution network from the dam consists of the main canal, distributaries and minors. The main canal is lined and is designed to carry 276 m³/s at maximum supply level. It will cover a distance of 235 km in the first phase. Distributaries, generally unlined, take off from the eastern side of the main canal. Some run short distances while others extend more than 25 km carrying 1.7 to 2.8 m³/s, with an irrigation network servicing areas of 20 000-40 000 ha. Minors draw water from distributaries and normally carry a discharge of 0.17 to 0.23 m³/s each. Water is delivered to farmers' fields from gated outlets on minors and sometimes directly from distributaries. Excess water from fields, as well as flows from distributaries and minors, drain into natural gullies that eventually join the Godavari river. Some of this water is collected by storage tanks that have existed for a long time and are primarily used for irrigating paddy in Kharif and Rabi seasons.

The climate is arid, with hot dry summers and mild winters. The mean annual temperature is 27°C, the maximum and the minimum range between 29°C and 22°C. The average annual rainfall of 944 mm is considered adequate for agriculture. But rains are unpredictable and unevenly distributed, making the area prone to droughts. Most of the rainfall occurs between June and September from the southwest monsoon, and some occurs in December and January from the northeast monsoon.

The terrain is undulating, featuring hillocks, gradients, large ponds, and flat lands. Two dominant soil types are found, both suitable for irrigated farming. About two-thirds of the land is light sandy red with shallow top soil. These soils are non-saline and neutral but are responsive to fertilizers and have good permeability.

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[1] Singh K.K. Farmers' Participation in Irrigation Management: The Pochampad Experience. Mimeographed, 1982.

[2] Achievement at a Glance. Sri Rama Sagar Project, Administrator's Office, September 1981.

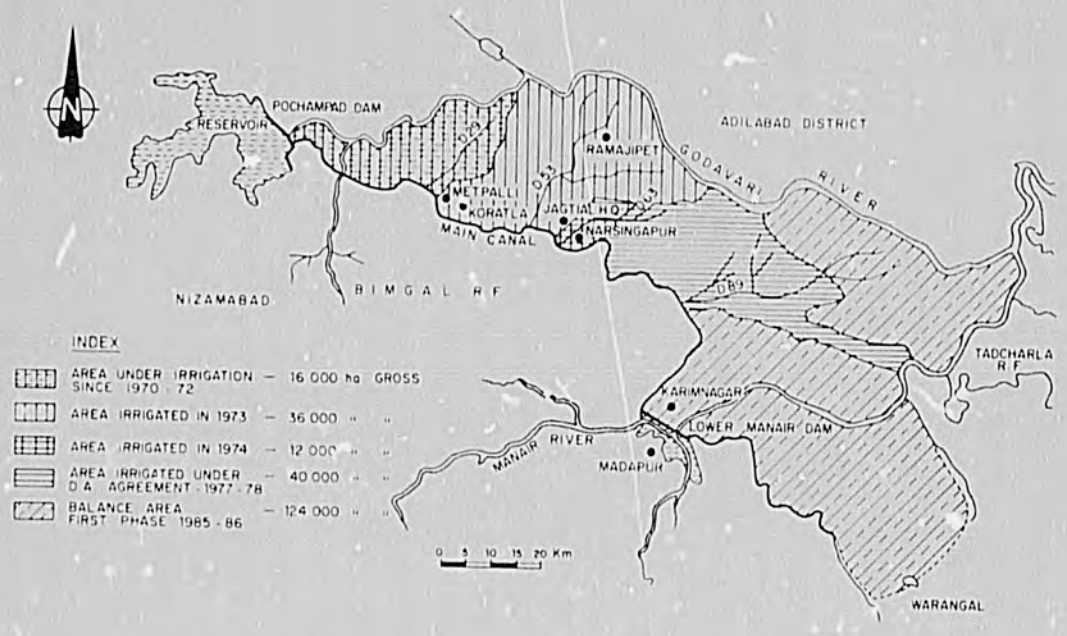

Fig. 1 Pochampad Project, Andhra Pradesh

They generally occur adjacent to hills and on slopes up to 3%. Erosion control and careful levelling are necessary for proper soil management under irrigated conditions. Heavy black soils, fine grained, usually deep with poor permeability and drainage, comprise one-third of the area. Traditionally, paddy has been grown in black soils. Such areas are used for wet (paddy) cultivation. Crops requiring little water are generally sown in red soils. These are used for irrigated dry crops.

A rapid rise in the groundwater table after the introduction of canal irrigation has been reported. Recent studies have shown an increase in the depth of the water table from 2 to 5 metres or more. Already some 20 000 ha of the area spread over 33 villages, is waterlogged, the water level rising to 3 m from the surface. Another 59 villages, covering an area of 60 000 ha, are potentially waterlogged. Because of concern over waterlogging and soil salinity, the government has encouraged farmers to instal private pumping sets to supplement canal irrigation and to keep the water table from rising beyond its present level. Black soils and the highly permeable red soils call for suitable drainage measures. Groundwater level is continually monitored. Drainage and escapes are being provided.

The quality of groundwater is fit for agriculture. The Godavari water contains moderate amounts of soluble inoganic salts, usually bicarbonates, chlorides and sulphates of sodium, calcium, manganese and potassium. The pH values vary between 7.0 and 7.6. Drain water has been tested. It is low in salt content and has reasonable pH values. It is therefore suitable for agriculture.

Before canal irrigation was introduced, irrigated agriculture was confined to areas having the benefit of tank and well irrigation. There were 2200 tanks and 44 000 wells irrigating an area of 65 000 ha out of 236 400 ha under cultivation. Paddy was and continues to be the preferred crop where tanks are available. Other irrigated crops were maize, tumeric, chillies and sugarcane. In rainfed areas sorghum, green gram, red gram and field beans were grown. Tank and well irrigation gave stability to agriculture in an area having unpredictable rains. Almost every village has a tank.

Human settlement is concentrated in villages that are multi-caste and multi-occupational in character. Population density is low, although villages are usually large with up to 5000 inhabitants. The surrounding area consists of agricultural land, forests and open country under shrubs and grasses. The distances between settlements are quite large. Before irrigation, many families were employed in non-agriculture occupations such as sheep herding, toddy tapping and stone cutting. Weaving and handicrafts also existed. Each village was dominated by a few socially powerful landowners called Doras, who owned 60 percent or more of the village land. They exercised enormous influence over the people, their tenants and servants, and over the local officials. Exploitation of the poor gave rise to covert resentment which led some political groups to challenge the tyranny of the Doras. Finding life increasingly insecure the Doras gradually migrated to larger townships including Hyderabad, the state capital. Although the peak period of conflict is over, social tension still exists.

With the coming of canal irrigation, a shift in the occupational and social patterns has taken place. All those who owned land have now taken to agriculture in a big way. Large areas under shrubs and forests have been brought under cultivation and this process is continuing with the help of financial and technical assistance for land development provided by government. Those who once considered themselves lucky to own an acre under a well or a tank for paddy or maize now grow a wide variety of crops with assured irrigation. Paddy, maize, tumeric and chillies are commonly grown under canal irrigation. Commercial crops such as sugarcane and groundnuts have also become popular. There is a substantial increase in the area under maize, groundnut and tumeric. The agriculture extension department has laid special emphasis on such crops as groundnuts, sesame and pulses. The yields of all the major crops have increased - by 150% for maize, 30% for paddy and 64% for sorghum. The assurance of protective irrigation for irrigated dry crops in Kharif should there be a long dry spell has encouraged doubled cropping. In some cases a third summer crop is taken using the last irrigation before the closure of the canal in April. Prosperity has increased. Many among the poor are living better than before. There has also been migration of labour from other areas. Agricultural wages have increased. Outsiders have purchased land to settle in the project area.

1.2 General Features of Canal Operation

Canal systems in India, whether run from storage dams or river diversion schemes, share some elements in common. The main canal is run continuously except for brief closutes for repairs. Branches or distributaries are operated continuously or in rotation. Farmers are expected to construct field channels to their holdings from a common watercourse which is constructed up to a certain length by the government.[1] Water charges are levied either at a flat rate as in Andhra Pradesh or for areas under different crops as in Maharashtra, Gujarat, Uttar Pradesh and other states. Water release is synchronized with crop coverage and water requirement at peak demand, making allowance for seepage and evaporation losses. The dates of canal operation are communicated to farmers well in advance of the day of release.

Canal operation and management generally correspond to the design of the canal system. Three different systems exist in India.[2] The canal system in northern states, including Rajasthan and Madhya Pradesh, is designed for protective irrigation. The idea is to provide at least two or possibly three irrigations to a large area as required. Water allowance varies from 1.75 to 2.50 l/s/ha. Water released for each irrigation takes into account crop coverage and the water requirements of crops. Distributaries are run in rotation for a specified number of days at full supply level so that all outlets discharge water simultaneously at full capacity. The irrigation department controls water regulation.

In Gujarat and Maharashtra, the distributaries and minors are run in rotation every 14 to 21 days. The outlets are gated and of standard size, unlike those in the north. Water release is correlated with the area to be irrigated in each crop season after inviting applications from farmers stating the kind of crop and acreage they propose to irrigate. The demand

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[1] In new canal projects field channels are constructed as far as farmers' holdings at government cost.

[2] Kathpalia G.N. Management of canal supplies and social environment. In: Utilization of Canal Waters: A Multi-disciplinary Perspective on Irrigation. K.K. Singh (ed.). New Delhi, 1983. CBIP. Publication No. 164.

schedule thus prepared shows the area under different crops in each outlet. The outlet gates are regulated to release water as per the demand schedule. Hence there are considerable variations in flow levels in minors since outlets do not yield a fixed discharge. The canal authorities are continuously engaged in regulating the flow of water.

1.3 Canal Regulation in Pochampad

In the southern states, including Andhra Pradesh, all distributaries and minors run simultaneously and continuously during the crop season. Control points are located at the head of the distributary and minors. Outlets are gated. Water releases take into account crop coverage and crop requirements in each month of the crop season. In the Pochampad project, for instance, the following releases were made for dry irrigated crops in 1979-80 (Table 1).

Table 1 WATER RELEASES FOR RABI 1979-80[1]

Month	l/s/ha*	Crop coverage (%)
October	0.52	50
November	0.42	70
December	0.52	90
January	0.69	100
February	0.52	70
March	0.27	30
	Average 0.49 l/s/ha	

* The above deliveries were made without taking rainfall into account. It is possible to manage with less water.

Three characteristics of the southern canal administration are worthy of note. First, canal officials do not have the authority to penalize farmers for growing prohibited crops or making unauthorized use of water. All such matters have to be referred to the revenue department. There is no direct contact between the suppliers of water and the enforcers of discipline. Secondly, the irrigation department does not report on the area irrigated by farmers for the levy of water tax. This responsibility also belongs to the revenue department. Hence, there is no direct contact between the farmers and the irrigation department as regards problems of water supply. Farmers often complain that they have to pay water charges without receiving water while some do not pay even when they take water. Thirdly, the field level personnel of the irrigation department are few and generally unskilled. A junior engineer is responsible for an area of nearly 3000 ha with the assistance of four canal inspectors and some 15 unskilled workers. It is not possible for this skeleton staff to supervise field level operations effectively. In all these respects, the northen canal system is better placed.

In other respects, however, the canal systems in north and south India are comparable. Canal operation and maintenance is generally considered less than satisfactory in both. Construction and design aspects have received priority, the best engineers are not given managerial responsibilities, and the grants are insufficient to meet maintenance costs.

Similarly, prople's participation in irrigation is quite limited. The irrigation authorities generally see their responsibility confined to canal regulation and administration. What happens to water when it leaves the outlet, and whether it is properly used, is a secondary concern. The usual approach is to look at the farmer from the top of the system rather than to view the system from the way it operates, at the field level.[2] Farmers' problems are seen as complaints, indiscipline in water use a sure sign of non-cooperation, and the farmers' inability to cooperate with one another a reflection of village power politics.

1.4 Irrigation Improvement: The CAD Programme

Since 1951 India has more than doubled its irrigation resources, bringing it to 56.6 million hectares in 1980 at a huge investment of Rs. 123 billion. This spectacular achievement, however, has not been without serious reservations about how well the irrigation resources have been used. Unofficial estimates place the gap between the created and the utilized irrigation potential in large and medium projects at around 50% of existing capacity.

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[1] Monitoring Review, Sri Rama Sagar Project, Jaqtial, 1980.

[2] Chambers R. Improving canal irrigation management: No need to wait. National Seminar on Policies for Irrigated Agriculture, Administrative Staff College, Hyderabad, February 1984. pp. 5-6.

The Irrigation Commission (1972) and the National Commission on Agriculture (1976) set up by the Government of India voiced grave concern over the under utilization of irrigation.[1] The main obstacle diagnosed was the neglect of the irrigation infrastructure below the canal outlet: field channels to farmers' fields, land levelling and shaping, drainage and so on. The Government proceeded to create command area development (CAD) authorities on all major irrigation projects to develop the field irrigation systems and to assist farmers in land development. The ultimate goal, however, was to increase agricultural production. Hence, agriculture and irrigation extension and better farm delivery systems were basic to the functions of the CAD authorities. Buildings, roads, warehouses, markets and growth centres followed from the concept of CAD as a comprehensive area development programme. The departments of irrigation, agriculture, cooperation (credit) and rural development were considered essential components of a CAD authority, to be suitably linked with others such as revenue, forests and financial institutions. And to coordinate their functioning under a common umbrella, a senior ranking official was to head each authority.

Between 1974 and 1976, most states set up CAD authorities. However, there were significant differences in their organizational design. In some states an independent administrative structure for CAD was headed by a secretary to the government or the agricultural production comissioner. Andhra Pradesh is one such state. In most others, one of the existing departments of government, usually agriculture, rural development or planning, was given CAD as an additional function. Only Maharashtra placed CAD under the irrigation department after an initial base in the agriculture department. The project level CAD organization also took different patterns. In some states, senior civil servants of the rank of commissioners headed the authorities while in others officers of the rank of joint heads of department, usually administrators and sometimes officers of the agriculture, irrigation or cooperative departments were put in charge, as in Andhra and Maharashtra.

The most important problem at the project level was to integrate the CAD function with the irrigation department, on the one hand, and to create engineering expertise for Chak development on the other. The first was openly resisted by the irrigation department in most states. Moreover, the irrigation engineer was not skilled in Chak survey and land development while the agricultural engineer who had the talent was not proficient, at least in the initial years, in the construction of field channels and drains. This meant that work teams consisting of irrigation and agricultural engineers having both kind of talents had to be formed to implement on-farm development. Another important skill was required: the ability to establish rapport with farmers and to persuade them of the benefits of Chak development, land levelling, introduction of a water rotation system and so on. The agricultural and rural development officials having had considerable experience in working with people were considered better at this job that the irrigation engineers and functionaries. The cooperation and revenue department officials had their own contribution to make, both as regards people's participation and specialized services. In short, the administrative organization for CAD at the project level had to provide the essential conditions for success: direct involvement of the irrigation, agriculture, cooperation and revenue departments (and some others) under a senior level administrator who could exercise administrative authority over the constituent units and, once such an administrative organization was created, to ensure that the various departments shared mutual responsibility in the performance of the many interdependent tasks which inevitably required close consultations with farmers.

The cooperation and the agricultural departments were brought under the Pochampad CAD authority but the irrigation department remained independent both at the project and the state level. On-farm development, being the major activity, was undertaken by systematic land development (SLD) divisions, comprising agricultural engineers with soil conservation experience and engineering divisions consisting of irrigation departmental personnel posted under the authority. However, the integrated nature of the main canal system and the Chak distribution system required close involvement of the irrigation department. The project authority succeeded in its effort to obtain the informal but active participation of the irrigation department. This contributed significantly to various innovations both in

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1 Command Area Development Programme in India - Achievements and Perspective. Government of India, Ministry of Irrigation, September 1981.

the administrative strategy followed for irrigation development and in involving farmers in irrigation management.

1.5 World Bank Assistance

The Pochampad project received assistance from the World Bank under two agreements. The first (1971-72) was for financial assistance for the construction of the dam and the canal network. As part of this agreement, a project coordinator was appointed at the state level to liaise with the government and the Bank. The second agreement (1976-77) was only for the CAD component, that is, land development, construction of field channels and drains and other items connected with the improvement of the Chak water distribution system.

Syed Hashim Ali, the Project Coordinator appointed by the Government of Andhra Pradesh, subsequently headed the new CAD department in the state and under his leadership policy decisions with far-reaching implications were taken. Hashim Ali's familiarity with field problems, and his early appreciation of the fact that the CAD programme cannot be successfully implemented without close collaboration with the irrigation department, on the one hand, and farmers, on the other, led to some innovations such as the concept of integrated water management, the team approach to irrigation development and the introduction of rotational water supply with people's participation.[1] The team approach helped in forming irrigation associations while rotational water supply depended on farmers' cooperation for satisfactory implementation.

2. FARMERS' ASSOCIATIONS IN POCHAMPAD

The Pochampad project is a unique example of popular participation and administrative innovation in irrigation development. The project authorities took the initiative in setting up irrigation associations, educating farmers, forming interdepartmental work teams, implementing rotational water supply and building among the government officials a service-oriented approach to people. The success in obtaining people's participation in irrigation development without legislative backing and bringing large areas under a system of rotational water supply goes to show how much a government organization can do on its own initiative.[2] The Pochampad authority succeeded in creating a close relationship with the public by virtue of the goodwill generated between its officers and the farmers. Whatever has been done was not conceived at the outset but evolved with field experience.

2.1 Pipe Committees: The Initial Phase

The first pipe committee or farmers' association for irrigation was tried out in 1974-75 as a pilot experiment in Chak development with total boundary realignment, consolidation of holdings and construction of lined field channels or ridges in Porandla village. The Commissioner in charge of the CAD programme decided to form a committee of farmers to assist in land development, agriculture extension and water distribution in the Chak. The committee had seven members, one each from the tail, middle and head reaches of the Chak, and four others. A literate farmer having leadership qualities was appointed the leader.

This experience was considered a success for it helped link the CAD programme with farmers. Pipe committees were then formed for each Chak although their composition and function changed somewhat. Two members belonging to the weaker sections of the community were included among the seven members. The functions were enlarged to include:

i. assistance in survey of the Chak, collection of agreement bonds for loans, assistance in land shaping and other aspects of on-farm development;

ii. adoption of the recommended cropping patterns, especially for ID farming, which was new to farmers and not readily acceptable to them; and

iii. involvement in the maintenance of field channels, distribution of water, enforcement of discipline and other matters bearing on water distribution.

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[1] The contribution of the project administrator, Syed Turabul Hassan, and the Superintending Engineer, Radhakrishna Rao, and their colleagues needs to be fully acknowledged.

[2] CAD legislation, "Andhra Pradesh Irrigation Utilization and Command Area Development Ordinance, 1983" is likely to be enacted in the near future.

Government officials working in villages sometimes met resistance from farmers. One officer reports:

"I was working on D63. Farmers did not allow us to survey the land. They said canal water will adulterate well water and adversely affect output. In one case farmers stopped excavation of a minor. We discussed matters, pointing out that a canal had helped farmers elsewhere and that a land survey was necessary for getting water to fields. Now everybody is anxious for on-farm development and for irrigation water."

It was realized, however, that once land development was completed, the committees had nothing more to do beyond discussing problems brought to their notice by government officials. They had not acquired any capability independent of that given by the administration. Doubts were also raised as to whether government officials should select members of the committee.

2.2 Pipe Committees for Warabandi: Irrigation Management Phase

The above state of affairs continued until 1978-79 when Warabandi, a system of rotational water supply, was tried out as a pilot experiment in two villages with the assistance of experts from the World Bank. Each farmer under Warabandi was required to draw water by turns on specified days of the week for a fixed time period worked out in proportion to his land holding in the Chak. For successful operation of the system, farmers had to adhere to the prescribed schedule and to respect the rights of others. Towards this, conventions regarding water sharing, responsibility for maintenance, settlement of disputes and the enforcement of discipline had to evolve. The task of irrigation management implicit in the functions of the earlier committees now became obvious. They had a continuing task to perform beyond the consultations for on-farm development or the layout of the Chak. There was, in fact, greater urgency for implementing land development since the proposed rotation system could not be tested in the field without it. The pipe committee now had an important function to perform: motivating the farmers to respond to the suggestions of the project authorities. Warabandi, therefore, created the conditions necessary for the sustenance of pipe committees.

The physical design of Warabandi, particularly the territorial grouping of farmers, and their interdependence on a rotational supply schedule, suggested the social design of the pipe committee. A Chak was divided into several irrigation zones taking into account the size of holdings, number of farmers and the direction of water flow (Fig. 2). The irrigation zone, a geographical entity, led to the notion of the irrigation group comprising farmers located in a zone. And from this emerged the idea of group leaders who could represent the interests of zones and also assist individual members. The idea of the pipe president followed logically from the fact that a pipe had several group leaders and a representative was required for the pipe as a whole.

The typical committee could have 7 to 10 members depending upon the number of irrigation zones in a Chak. Table 2 gives the social design of the committee for one Chak in the village of Narsingapur. This Chak has 11 irrigation zones (groups), A to K. In each there are 9 to 15 farmers. The total area farmed is 39.16 ha and the number of farmers is 138. Both night and day irrigation are practised. Water is supplied 24 hours a day starting from 5.00 am on Monday to Group A and ending at 5.00 am the next Monday, in group K.

The initiative exercised by the government in selecting the members of the pipe committee now passed to the farmers and with this a different emphasis on functions came about. Superimposed on the earlier concern for land development and cropping pattern was the responsibility for water distribution. The pipe committee had to ensure that everybody got water in turn, nobody usurped the rights of others and that the costly irrigation infrastructure was preserved and upgraded to continued service. Instead of the field level personnel of the government looking into each and every detail of a Chak, farmers began to be involved in the management of Chak affairs. Government officials now became resource personnel, helping farmers solve difficulties.

2.3 Functions of Pipe Committees

The members of the pipe committee became responsible for looking after the water distribution system within the Chak and communicating difficulties, especially of a technical nature, such as poor flows or lack of water supply, to the official agency. Once the pipe committee had been formed, individual and collective responsibilities were explained. Emphasis was placed on the necessity to observe turns, settle disputes amicably, maintain the irrigation

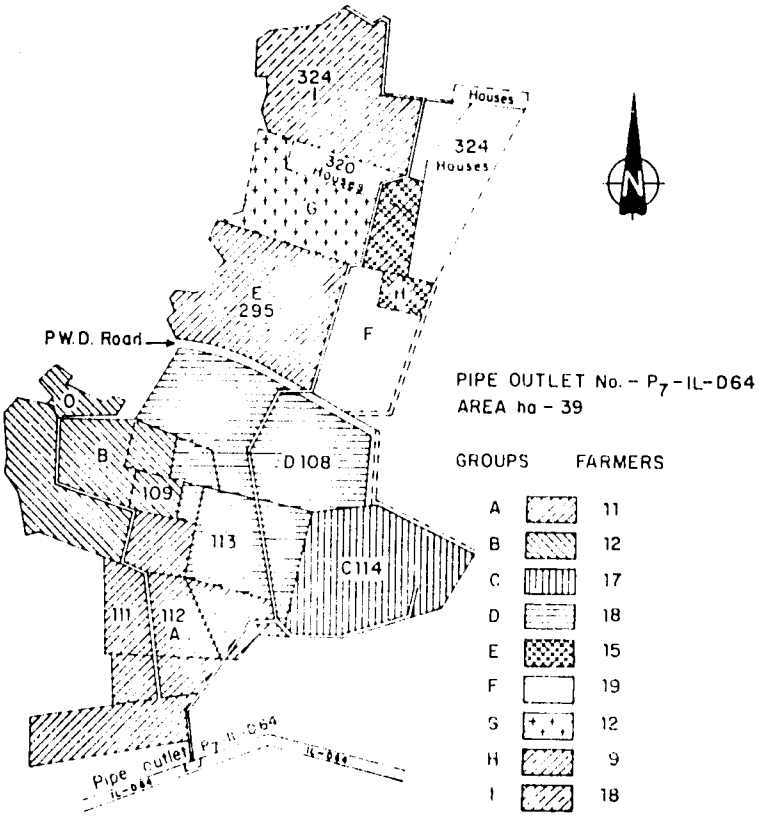

Fig. 2 Sri Rama Sagar Project - Village Narsingapur

Table 2 WARABANDI SCHEDULE: VILLAGE NARSINGAPUR PIPE 7 (D-64, IL)

Group	No. of Farmers	Actual No.* of farmers	Hectares	Total Hrs.	From Hrs.	To Hrs.	Distance from Pipe Outlet (m)	Days
A	11	11	3.76	13.25	0500	1825	61	Monday
B	12	10	3.44	13.25	1325	0750	357	Mon - Tues
C	17	14	4.36	18.40	0750	0030	148	Tues - Wed
D	18	14	6.03	23.45	0030	0015	358	Wed - Thurs
E	15	11	3.12	13.15	0015	1330	668	Thursday
F	19	18	2.15	9.10	1330	2240	690	Thursday
G	12	11	1.93	8.40	2240	0720	925	Thurs - Fri
H	9	9	0.81	3.35	0720	1055	939	Friday
I	18	15	3.78	17.45	1055	0440	1102	Fri - Sat
J	16	15	5.88	29.05	0440	0945	1276	Sat - Sun
K	11	10	3.91	19.15	0945	0500	1382	Sun - Mon
11 grs		138	39.16	168.00				

* Excluding farmers whose names appear in other groups.

infrastructure, irrigate fields intelligently and to grow crops that promise good economic returns as advised by agriculture officials. The following functions of the pipe committee emphasized:[1]

i. to oversee the proper allocation of water as specified in the Warabandi schedule and to effect adjustments when needed;

ii. to maintain the irrigation system and collect such maintenance charges as may be agreed upon by the pipe committees;

iii. to resolve disputes and differences relating to water sharing and to prevent wilful damage to field channels and structures;

iv. to share information with regard to agriculture practices, especially crop water requirements and cropping patterns;

v. to convene meetings at least twice a year or more often if necessary; and

vi. to link with the official agency for services required in the interest of the beneficiaries.

Additional functions may include supervision of paid employees, undertaking maintenance and repairs, facilitating land development and coordinating the supply of farm inputs such as fertilizers, seeds and implements, to the farmers.

A committee of representatives of pipes along a minor or a distributary was proposed to deal with the shortcomings of the main canal system, unlawful tapping and obstructions, and to exert pressure on the CAD authority to deliver efficient service to the beneficiaries. Such an association of "minor" or "distributary" representatives, however, has not yet been formed.

2.4 Administrative Strategy: The Team Approach

In 1979-80 Warabandi was implemented on 100 minors serving an area of some 8100 ha. In the following year the area was doubled. It was now important to develop an administrative strategy to link the formation of pipe committees with irrigation development and management. Earlier, the committees had been formed by the SLD units that comprised agriculture engineers responsible for Chak surveys and Chak design plans. Execution of plans was assigned to the engineering divisions posted under the project authority from the irrigation department. With the introduction of Warabandi Chak development had to be taken up simultaneously with the education of farmers, improvements in the main irrigation system, introduction of rotational water supply and overseeing its operation in the Chak. The separation between the SLD and the engineering divisions was no longer tenable. The pace of work and the need to involve people on a continuing basis called for a new administrative response. The solution came in the team approach. A deputy executive engineer or an assistant director agriculture were chosen to lead a team consisting of the cooperative supervisor, agriculture extension officer, assisted by the irrigation supervisor and the village revenue officer. The support of the last two officials was ensured through the intervention of superiors.

Pilot Warabandi in 1978-79 had clearly demonstrated that few canal minors were in good enough condition to adequately meet the requirements of a Chak distribution system.[2] Warabandi could not be implemented unless the vulnerable portions of the main system had been upgraded, additional control structures provided and measuring devices installed. Since the irrigation department was not under the administrative control of the authority, improvements in the main system could not be made by CAD authorities. The goodwill that existed between senior CAD officials, particularly the project administrator and the irrigation engineers, made it possible for team leaders to enlist the active support of the irrigation supervisor. Cooperation of the village revenue officer, bank officials and others was obtained through fortnightly meetings. Members belonging to each team were identified by name and given time-bound work plans. Thus, instead of the

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[1] Syed Turabal Hassan. Farmers' Organization in Sree Rama Sagar Project. Workshop on Farmers' Organizations, Indian Institute of Management, Bangalore, 1980.

[2] Hashim Ali S. Practical experience of irrigation reform Andhra Pradesh, India. Discussion Paper 153, IDS, Sussex, England, 1980, pp. 11-12.

Approximately Rs 10 000 had to be invested on each minor to make it capable of delivering water to the required standard.

engineering divisions working on their own to solicit cooperation from others which may not have been forthcoming on time, the concerned officers now worked as members of a common team sharing joint responsibility for assigned tasks.

It was important to orient individual team members to common tasks and to make them feel responsible to each other. Officers had to be trained and fully prepared to work with farmers, for educating and motivating them and, at the same time, listening to them and understanding them. Some did not believe they could ever get water. Those who had access did not feel the need for another system. Those growing paddy were least inclined to accept a new arrangement which would only permit the cultivation of dry irrigated crops such as maize, millets and tumeric. Officials also had doubts of their own. Many were not convinced about Warabandi. Working in an interdepartmental team called for a radical departure in thinking and work relationships. The administration too faced a difficult situation. In addition to forming work teams and putting them to work, the CAD organization had to be fully mobilized to link its sub-systems with various agencies such as credit institutions, agro-industries corporation and the departments of irrigation and revenue, on the one hand, and a sizeable population of farmers spread over a large irrigation command on the other. Under these circumstances, action strategies could scarcely be planned in advance. There were too many gaps in knowledge and uncertainties about how to proceed. No dependable framework for action was available. The first step had already been taken inasmuch as irrigation associations and interdepartment work teams had been created. But what training to impart to officials and farmers, what functions to assign to pipe committees, how to strengthen them and the work teams, how to monitor field problems and supervise activities were among the important questions for which no ready answers were available. There were no specialists to guide the project authority in these matters. The systematic approach to irrigation associations followed in the Philippines[1] or the ongoing Gal Oya programme in Sri Lanka[2] were not available in Pochampad. The project authority had to pool its own resources and take steps that seemed appropriate given the existing state of knowledge and experience with field conditions.

Agriculture and CAD engineers were given the responsibility for educating farmers, particularly the group leaders and the pipe presidents. The supervisors (irrigation and CAD) discussed on-farm development plans and the need to construct field channels, division boxes and drop structures according to the maps prepared earlier. The cooperative supervisor talked about credit while the agriculture officer discussed agriculture matters and helped convene meetings of the pipe committees. The revenue officials provided land records and titles which helped the engineers and the cooperative officials in their work. The irrigation department coordinated its work in respect of upgrading minors to ensure the desired discharge of water in the outlet.

Having established contact with the farmers in villages, the teams proceeded in the following manner:[3]

i. the irrigation department upgrades the minors by constructing cross regulators if necessary, and installing measuring devices at suitable locations;

ii. the map of each pipe is prepared indicating the holdings of each farmer, field channels and the internal field channels to each individual's land;

iii. field channels capable of carrying water with designed discharge are constructed by the irrigation and CAD engineers down to each holding;

iv. irrigation schedules are calculated and displayed indicating time and day when water will be delivered to each farmer;

v. the area within a pipe is divided into groups (zones) based on

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[1] Bagadion B.U. and Korten F.F. Developing viable irrigators' associations for small scale irrigation development in the Philippines. Network Papers 20/80/2, ODI, London, 1980.

[2] Uphoff N. The Institutional-Organizer Programme in Gal Oya, Sri Lanka after thrity-three months in the field. Mimeographed, January 1984.

[3] Syed Turabal Hassan. Evaluation study of Warabandi rotational water supply system under Sree Rama Sagar Project Command Area. Mimeographed, Jagtail, 1981.

physical location of field channels and convenience of water distribution. Group leaders and pipe presidents are selected in consultation with the farmers, and informed about their respective responsibilities;

vi. technical know-how and funds are made available to the farmers for their on-farm work with the assistance of engineers, bankers and cooperative department officials; and

vii. agricultural practices and cropping patterns are discussed, and information on water requirements of the crops and irrigation shared.

2.5 Sustaining Team Work and People's Participation

No formal orientation training was given to the implementation teams. Each was assigned an area of about 800 ha and as soon as the work was completed the team moved on to another location. The normal work area of a sub-division headed by a DEE/ADA is around 1200 ha. This norm was kept in sight, making adjustments for the additional responsibilities given over and above the normal duties of a sub-division. A rather interesting method of training and supervision was evolved, again, not by design but to give direction to activities in the absence of a dependable framework for guidance.

i. Fortnightly Warabandi meeting at headquarters: Fortnightly meetings were held at the project headquarters. Officers of all concerned departments including the most senior, were invited. Attendance was very good for 70 to 80 officers were usually present. Each team reported its progress. A variety of problems was discussed. The meetings help monitor performance and also suggest solutions to problems. Good performance was acknowledged and shortcomings identified. On-the-spot decisions were taken whenever required. An important contribution of the meetings was to keep senior officials fully informed about the progress of work. Discussions highlighted current needs and deficiencies. The interest taken by superiors stood as an example to subordinate officers. Since the objective was to help teams become more effective, the discussions were invariably positive. Defensive reactions, common in government meetings, were generally absent.

ii. Location meetings: The senior officials accompanied by team leaders often called meetings in various places where work was in progress. The purpose was to establish mass contact with farmers. The Warabandi programme, importance of land development, better choice of crops and similar issues were discussed and the officials responsible for work in the area were introduced to the people. These meetings were intended to prepare favourable conditions for village-level meetings that were organized by team leaders shortly afterwards.

iii. Joint tours: The fortnightly meetings identified problem areas of special difficulties that could not be tackled by the teams. It was customary for senior officials, usually accompanied by the project administrator, to visit the place in question on joint inspection tours. Officials in charge of work in the area, particularly those belonging to irrigation and revenue departments, were requested to come. Team leaders, their immediate supervisors, the field level functionaries of various departments and, almost invariably, the concerned farmers were present. After obtaining first-hand experience, solutions were suggested as, for instance, in one case where farmers were advised to deepen the minor so as to get a better supply of water. And for this they willingly contributed labour under the guidance of the project engineers. But no less important tours provided an opportunity to discuss a wide variety of other issues, particularly the problems faced by farmers. The meetings gave officials the opportunity to learn from farmers and also to educate them. The way a situation was handled in the context of manifest problems and their underlying causes was a training experience for all, including the team members.

iv. Farm demonstration: The government farm in Chelgal village is a demonstration and experimental centre for various agriculture and irrigation practices. It has helped government officials keep in touch with the latest developments in agriculture and

irrigation extension. Demonstrations on farmers' fields have been found particularly useful by the agriculturists.

v. Zonal meetings: A later innovation was zonal meetings to which all farmers belonging to the area where irrigation development was about to be taken up on a large scale were called. One such meeting attended by government officials, farmers, team leaders and representatives of commercial and cooperative banks was held in Sultanabad in April 1980. Some 350 people attended. The Tahsildar (revenue official) was asked to chair the meeting. Senior officials of the irrigation, cooperative and agriculture departments, the project administrator and bank officials addressed the gathering. Each discussed the plan for irrigation development and what was proposed to be done by the speaker's department or agency. Officers who were in charge of operations in the area were introduced individually. After the presentation by officials, the meeting was thrown open for general discussion. Many farmers expressed their own views and what they expected from the government. Some notable suggestions offered by the farmers and accepted by the project authority are noted below:

a. the government staff responsible for irrigation development should stay in the area and the village people would make arrangements for their stay;

b. pipe outlets should be placed in location by the irrigation officers rather than others (contractors); the irrigation officers agreed to indicate the place where the outlets were to be located;

c. dissatisfaction regarding loan disbursement was voiced by farmers who were particularly critical of the revenue officials; and

d. it was agreed that farmers could make temporary field channels to enable them to draw water if the work not completed in time.

Several meetings of this kind were convened in other places. They brought the project authorities close to the people and helped achieve one important result: winning the confidence of the people and establishing a link based on open communication between the farmers and the government administration. They also encouraged active people's participation in pipe committees.

3. PERFORMANCE OF PIPE COMMITTEES

It is now pertinent to ask whether the pipe committes performed the functions expected of them, whether the group leaders and pipe presidents understood their responsibilities and whether people's involvement in irrigation management made a visible impact on agriculture and irrigation.

This discussion draws upon the findings of a study referred to earlier in which seven outlet commands in five villages, namely Narsingapur, Ramajipet, Mootapally, Zabitapur and Ibrahimnagar were studied in detail in an attempt to understand farmers' participation in irrigation management. The survey covered an area of 161.3 ha and a sample of 274 farmers. A sample of 50 group leaders and 50 pipe presidents was taken, some drawn from pipes outside the study sample. A comparison of Chaks with and without Warabandi was also made.

3.1 Pipe Committees and Rotational Water Supply

Farmers generally agreed that Warabandi was a superior method of irrigation. Free access to water at all times is believed to lead to conflicts because the socially dominant and "tough" draw more water than their legitimate share which then creates scarcity for others. Challenging such people is not without unpleasant consequences. Warabandi was considered desirable for two important reasons: it obviates social conflicts and gives certainty about the time and quantity of water supply. Both were considered strong points in favour of an orderly farm distribution system.

A large majority (76 percent) of farmers were able to describe Warabandi as a method of taking water once in a week by turn during certain hours indicated by government officials. Most (64 percent) were also aware of the day and time of their own turn. Of those who were not, many said they knew their place in the sequence and came to take their turn accordingly.

Sixty percent knew the names of group

leaders but only 30 percent knew the exact number of farmers in the group. Knowledge about the members of the committee and the functions of the committee was found to be related to the effectiveness of extension contact. In one village 86 percent of farmers knew the group leader as compared to 4 percent in another where extension contacts had been poor because the village extension officer was said to be away most of the time.

One-third said that CAD officials had selected the group leaders. Government officers responsible for forming the committees had suggested the names of some who might make acceptable leaders. ne-quarter, however, mentioned discussion and consensus over the selection of group leaders. Many did not recollect how the group leader was chosen (46 percent), the largest belonging to the village with the absentee extension worker. About 60 percent of farmers knew the functions ot the leader. Most prominently mentioned were adherance to the time schedule (25 percent) and maintenance of irrigation structures (20 percent). Representing the interest of the group in irrigation matters was mentioned by 10 percent and the settlement of disputes by 7 percent.

Nearly 70 percent of farmers did not know how the pipe president was selected. About 13 percent believed that the CAD officials had selected them while some 17 percent said that the selection was unanimous or in consultation with the villagers. As regards any problem on which help from the pipe president was received, 90 percent said they had no occasion to ask for assistance.

Farmers were more aware of the group leaders than the pipe president. Enforcement of turns and the maintenance of irrigation structures were the two most important items for which the group leaders were thought to be responsible. Nearly one-third said they were very satified with the group leader and another 16 percent did not find any reason to complain.

The overwhelming majority of pipe presidents (88 percent) and a smaller number of group leaders (60 percent) felt that they had important functions to perform. Ensuring adherence to the rotation schedule to avoid conflicts was mentioned by the largest number, followed by repairs of field channels and irrigation structures. Referring problems to government officers was also mentioned as a function but by a small number. Most said that they had taken an interest in getting field channels repaired and also in enforcing the rotation schedule. However, in regard to sharing information on agricultural matters or use of the right quantity ot water, only one-third answered in the affirmative. Discussions revolved round the use of water and occasionally crops and fettilizers. Since the pipe committees did not meet too often, the discussions were usually informal.

3.2 Meetings and Follow-up

Meetings of the pipe committee were not held frequently. After the first few meetings in which committees were formed and their functions as well as those of the members explained, there was little systematic follow-up. Initiative in convening meetings was taken by the committee members and sometimes by the village agricultural officers, some of whom took a personal interest in them. Interest in irrigation associations is influenced by the nature of village leadership. In one village, Ramajipet, the village leaders took the initiative in convening meetings and discussing various problems. They also guided farmers regarding turns and in settling problems. In Narasingapur, only a few meetings could be held while in Mootapally none were convened.

Most group leaders did not mention having received complaints from farmers. Such as were referred to them were dealt with directly or sometimes referred to government officials. It is significant that during 1979-80 the water supply was very good. In the following year, under conditions of stress, committees faced difficulties but by and large they were able to deal with the situation. Only those problems that arose from the behaviour of upstream villages could not be tackled and several of them remained unresolved even after the intervention of the project officials.[1]

3.3 Irrigation Development and Water Utilization

Pipe committees have speeded up land and water development. A Chak which earlier took about one year to develop could be completed within 4 to 6 months, sometimes more quickly. The team approach has definitely helped here. But people's participation hastened the process. Comparative figures show that 34 percent of farmers under the non-Warabandi Chaks reported not getting water as compared

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[1] See section 3.5.v.

to only 4 percent under Warabandi. This is due to the proper layout of the Chak distribution system, speedy land development and the fact that committee members support the claim of individual farmers to water and thereby prevent the socially dominant or the unruly from taking more than their share. The pace of land development under Warabandi is shown in Table 3. Considerable progress has been made since 1979. The pace of implementation has picked up since 1981-82.

Warabandi is known to increase the area under irrigation. Table 4 shows that an additional 28 percent of land was brought under irrigation after Warabandi. It is interesting that 13 percent of the Chak command was still unirrigated, largely because farmers had not developed their land. An overall estimate of the additional area brought under irrigation after Warabandi is around 35 percent of the Chak command.

3.4 Agriculture and Income

Crop coverage increased substantially after Warabandi. In one village it rose from 59 to 97.1 percent and in another from 32 to 78 percent. The areas under under maize and tumeric, increased by 33 and 113 percent respectively. In five Chaks with an area of 108 ha, it was found that after Warabandi in the area under groundnuts increased more than four times, there was a 33 percent decrease in paddy and a 70 percent decrease in sorghum.

Investment in seeds, fertilizers, pesticides and labour has increased, particularly in seeds, while investment in implements has declined (Table 5). Agricultural incomes have also increased. Official statistics collected by the project authority show an average income of RS 4510/ha/year compared to RS 2700/ha/year before Warabandi - a net increase of about 67 percent.

It is difficult to separate the impact of pipe committees from that of the water distribution system on crop coverage, choice of crops, farm investments and agricultural incomes. Nevertheless, the involvement of the people in the water distribution system, contacts made by the project

Table 3 AREA UNDER WARABANDI (1000 ha)

Year	Minors	Pipes	Area	Villages	Implementation teams
1979	2	9	0.29	2	2 officers
1980	100	371	6.76	47	11 teams
1981	200	1042	16.19	126	20 teams
1983*	600	3000	50.58	330	20 teams

* Figures are partly estimated.

Table 4 IRRIGATION BEFORE AND AFTER WARABANDI (in 26 pipes) (ha)

Total area	Area irrigated before Warabandi	Additional area irrigated after Warabandi	Area unirrigated after Warabandi
448.4 (100%)	266.0 (59%)	124.6 (28%)	57.9 (13%)

Table 5 INVESTMENT IN AGRICULTURE (KHARIF) (in Rupees)

Input	1979		1980		Difference		Percentage	
	Total (in '000s)	Per ha	Total (in '000s)	Per ha	(1980-1979) (in '000s)	Per ha	Total	Per ha
Fertilizer	33.8	595.5	42.3	663.5	8.5	68.0	25.0	11.5
Seeds	2.3	41.3	10.8	170.3	8.5	129.0	364.0	313.0
Pesticides	2.4	42.3	2.9	46.5	0.6	4.2	24.0	10.0
Labour	21.6	381.5	27.3	428.2	5.6	46.7	26.0	12.0
Implements	5.4	94.5	5.4	84.3	.01	-10.2	0.01	-10.8

authority in connection with land development and subsequently agriculture extension do suggest that the open communication between the people and the government developed in Pochampad has helped both increase the irrigated area and crop output. Yields have not increased as significantly as the total output.

3.5 Irrigation Management

Five functions of the pipe committee were stressed in particular. These were: (i) water distribution; (ii) conflict resolution; (iii) enforcement of norms and prevention of wilful damage to structures; (iv) maintenance of irrigation infrastructure; and (v) linkage with government agencies for information and feedback.

i. Water distribution

The pipe committees dealt with water distribution quite well. In 1979-80 when the survey took place water supply was generally abundant. The test of the system came in 1980-81 when there was 40 percent less water than the previous year relative to the size of the expanded command area. Instances of deliberate tempering with irrigation structures were few and this fact was attributed to the pipe committees. Kashi Rao, a group leader of the first Warabandi pipe, said:

"The pipe committees are functioning well. We ascertain whether everyone is getting water on time. We ensure that no one fights and that tail enders and the small farmers who sometimes do not get water, receive their due share. The pipe committee meets one or twice a month and also discusses the crops to be grown. We seek the advice of village elders when a complaint comes to us. When the flow is inadequate we approach officers in Raikal and Jagtail. Some farmers did not get loans for land development. We went to Jagtail and pleaded with the officers."

Similar sentiments are expressed by others. Another farmer from the same village says:

"Group committees are functioning. They ensure there is water for everybody. The influential people in the village also cooperate with the pipe committee. When there is a water shortage we inform the group leaders and they go to Raikal to talk to the engineer. Village officers also visit twice or thrice a month. They advise us about crops, fertilizers, etc."

There are, however, differences in the experience of farmers in different villages. In Narsingapur (Fig. 2), the rather elongated pipe created tail-end problems. The residents of the two tail-end hamlets did not receive enough water. Although this was brought to the attention of the CAD authority, the situation could not be rectified until two years later. In another village where extension contacts were not particularly satisfactory, the members of the pipe committee were unsatisfied. Many felt that not enough interest was being taken in their problems. They were displeased with the village officer who was frequently absent. When water was scarce in 1980-81, the pipe committee in this village virtually broke down because the upstream villages took more water and would not listen to them. The project authorities also failed to change the situation. However, some farmers pipe asserted their rights against the more influential people of the village and took their share of whatever water was being delivered. An elderly farmer, knowing that he might not be able to assert himself, irrigated his fields at night when there was less competition. The point to be emphasized is that the distribution system legitimizes one's right to water. Once this right becomes a public knowledge there is confidence among people to assert themselves.

ii. Conflict resolution

Ignorance about turns, the feeling that someone takes more than their allotted share and irresponsible behaviour on the part of the other person are among the important causes of conflict. The pipe committee, especially group leaders and the president, are expected to look into such cases and find amicable solutions.

Disputes between farmers which arise from lack of correct information about turns are easier to resolve than those caused by people trying to take too much

water of trying to intimidate the "weak". Disputes due to insufficient water because upstream villages behave unlawfully are even more difficult to tackle. Appeal to superior authorities is the only solution in the absence of an organization at the level of the minor to deal with such problems.

Pipe committees have been fairly successful in dealing with some disputes while they have failed in others. Sometimes, resolution is sought outside the forum of the farmers' organization. In one village, the holdings of a farmers had to be irrigated from three different points. One approach was objected to by a villager as water threatened the wall of her mud house. Having failed to persuade the lady to allow passage, the farmer approached his group leader. A meeting was called to examine the situation. It was found that a culvert had obstructed the flow of water. The farmer was told either to deepen the channel or to irrigate from the remaining two points. Many such problems were solved by the intervention of group leaders in consultation with members of the group.

In another case, a dispute between two farmers whose turns came in succession led to physical confrontation. The aggrieved farmer reported the matter to the caste Panchayat (not to the farmers' organization) since both belonged to the same caste. After due deliberation the Panchayat decided against him. But this was not an informed decision. The complaint was just and had the members of the irrigation group discussed the issue, the outcome could have been in favour of the aggrieved farmer.

Success in the settlement of disputes between members of two different pipe groups have not, to the best of knowledge, been settled by the parties themselves. Usually, the authorities intervene to prescribe a solution. A few instances came to notice where illegal cultivation of paddy by upper reach farmers had been effectively stopped on the initiative of middle and lower reach farmers with the assistance of the irrigation authorities.

iii. Enforcement of discipline

In old community-managed irrigation schemes, norms have been evolved regarding the enforcement of discipline, and the provision of voluntary labour for maintenance and monetary contributions for repairs. Such norms have not so far been developed by pipe committees created in the Pochampad project.

Apart from indiscipline motivated by the desire to have access to water at convenience, there has been wilful damage to irrigation structures installed to measure and regulate the flow of water. Farmers, by and large, do not understand the purpose of the various artifacts. Social pressures cannot yet be brought to bear against offenders. The pipe president in one village found himself totally ineffective as, according to him, "nobody listens to me".

Norms develop over a period of time. Frequent meetings and discussions between farmers help emphasize appropriate conduct and attitudes. The Warabandi meetings in one village (Ramajipet) were used to emphasize the importance of irrigation structures. "It was decided", says a group leader, "that irrigation structures should not be damaged, and whoever breaks them will have to restore them. It was also decided that Warabandi was beneficial to farmers and we should keep it up." Meetings helped to develop common standards to judge the appropriateness of behaviour. Indiscipline has been minimal in this village. But not many villages have received the quality of extension and official support that Ramajipet received.

Dissuading farmers from growing paddy has been a recurrent problem for the project authority. In one year when monsoon rains failed, farmers in the upper reaches of many distributaries started taking water for paddy on a large scale. They also succeeded in getting some political backing. The project authorities contacted the tail enders on some of these distributaries and found them quite responsive to the suggestion to prohibit paddy in the upper reaches. A meeting was held in which the local MLA was virtually shouted down by the farm-

ers. Thereupon, one distributary was shut off for one week to emphasize to the paddy growers that they might be the worst sufferers. After this the norms of dry irrigated cropping were again respected. Unauthorized paddy growing ceased. Many farmers were pleased at the success they had achieved.

iv. Maintenance of the irrigation infrastructure

Maintenance of the irrigation infrastructure at the farm level is one of the important functions assigned to pipe committees. Field channels have to be excavated, weeds and silt removed and necessary repairs carried out. There were instances where farmer groups had volunteered to deepen several kilometres of a minor to enable water to reach the village. However, when someone's cart accidentally broke an underground pipe, reducing availability of water to the tail end, a satisfactory solution could not be found.

Farmers in Pochampad are willing to contribute towards the cost of maintenance. Many feel they must take care of the irrigation structures and contribute to repairs. Many agreed that anyone who damaged a structure should be fined. An overwhelming majority (70-80 percent) considered maintenance the responsibility of farmers. The minority that did not hold this view felt that the government should carry out maintenance since the farmers pay irrigation charges. Most felt that maintenance charges should be levied relative to the area held by a farmer in the outlet command (85 percent). A contribution of Rs 50-75/ha was considered adequate. A fairly large number felt that the cost of repairs should be estimated and farmers asked to pay in proportion to their holdings. In other words, they did not favour a fixed charge.

When asked who should collect funds, 80-85 percent of farmers saw it as the responsibility of group leaders and pipe presidents who should also get the repairs executed. Those who saw maintenance as the responsibility of the government (15 percent) either did not get any water or received an adequate quantity. It is natural for them not to feel responsible for maintenance. Discussions with farmers in a few villages showed that possible misuse of funds collected for maintenance could be prevented. Some felt that a close watch could be kept on those given the responsibility. Others suggested that an account could be opened in a bank or a post office in the name of two individuals. Funds could be withdrawn according to need and a statement of accounts submitted to the total membership at one of its meetings. Some suggested that the government should oversee the expenditure.

Farmers were quite willing to raise funds provided a method of collection, deposit and expenditure was established.

Responsibility for maintenance is clearly accepted by farmers. However, no group effort has so far been made in spite of the favourable sentiments expressed. In the village referred to earlier where an underground pipe had broken and a large area, including the road, was flooded farmers did not collect money for repairs in spite of several attempts made by the pipe president. The sufferers were the tail zones (Fig. 2) who belonged to another settlement although of the same village. In some other villages, however, a voluntary contribution of labour was made and the pipe committees and the village leadership have taken interest in Chak maintenance. Popular participation seems likely to ensure the upkeep of the Chak.

If farmers can carry out repair and replacement they will save government enormous sums. The annual maintenance cost for the 3000 outlets under Warabandi up to 1983 is conservatively estimated at Rs 2 490 000 ($ 249 000). Without repair and replacement, by either government or farmers, the system would gradually go out of operation.

v. Linkage with Government agencies

Links with concerned government agencies are important for two reasons: first, for receiving advice and taking decisions on matters of common interest that

require the support of all the farmers, such as choice of crops, agronomic practices, and economical use of water according to crop requirements; secondly, for conveying information from the farm level up to the agency on issues that are important for the satisfactory performance of the Chak system. Relevant factors here include: the behaviour of the main canal system, wasteful use of water in the upper reaches, conflicts that farmers cannot resolve, misuse of position by lower level government functionaries and a dialogue on problems on which an understanding between the farmers and the irrigation authorities is required.

Linkage and feedback is the worst performed of the five tasks expected of farmers' organizations. But they are not to blame. Farmers often take problems to higher levels of government but usually they return disappointed. "The village elders and the pipe committee leaders went to Raikal and Jagtail to tell the officers of water shortage. They were assured that something would be done but nothing has been done. The farmers had written to the administrator in Jagtail and also to the higher authorities in Hyderabad, but nothing was done. Even now we are not getting enough water."

Failure to develop an effective link with farmers is partly an outcome of an administrative system that has largely believed in acting top down rather than building a relationship from the field level, where most of the people live, up to higher levels of government. For instance, the CAD authority has a monitoring and statistics unit to collect data on programme targets and fulfilment. It is neither people-oriented nor problem-oriented. Until information gathering and feedback become an integral part of the project authority, it is not possible for officers, in their individual capacity, to deal with the many problems that are continually referred to them. This failure arises from the general orientation of public systems. It is difficult to understand how canal systems can be operated for maximum water utilization if due regard is not paid to monitoring field problems and understanding the difficulties of farmers and the way they see things.

4. A PERSPECTIVE ON VIABILITY

In the course of five years, some 3000 pipe committees have been formed, a large number of which seem to function reasonably well. This has established that farmers are both desirous and capable of participation in irrigation management and that irrigation associations can be sustained on large irrigation projects. It is noteworthy that the entire initiative came from the government. The administrative strategy changed with experience and became progressively more effective. No additional funds were invested except for upgrading the minors. No additional staff were employed. The coordinated function of implementation teams compensated the need for additional personnel.

What has contributed to success? First, the belief of the senior project officials that the beneficiaries of irrigation, the farmers, must be fully consulted and involved in irrigation matters. Meetings at the project headquarters, field level meetings and the zonal gatherings emphasized this important point. From this belief followed a people-oriented approach as against an administrative approach to Chak development. Officers faced problems directly rather than deputing subordinates to report on facts. Most officers were conscious of a change in their own work attitudes. One deputy executive engineer, who had come to Pochampad on transfer from the irrigation department, made an observation which speaks for others:

"Many farmers had complained they are not receiving water. I started visiting villages. One farmer, for example, said he was not getting water. When I went to his field I found it was true. The field channel was running next to a well and a farmer was letting water into his well (to cultivate paddy). Many such things came to notice. There is more people contact here and more job satisfaction. One sees people benefitting from what one does. I have learnt to deal with people. I also have a better understanding of other departments. Before I came here I felt I was the governor. Now I am one with the people."

Another factor is the confidence among farmers that they will get their share of water and will be treated justly by the project authorities. This assurance motivated them to plan their agriculture and to grow crops that offered better returns on investment

(tumeric, groundnuts and sugarcane). It also provided the incentive to cooperate with the government and the irrigation association: the former in respect of loans and recommended agricultural practices and the latter as regards self-discipline in taking water, deciding on norms and adhering to them, contributing to maintenance and cooperating with committee leaders for settling disputes.

With few exceptions, pipe committees tried to perform their assigned functions. They met with varying degrees of success. They were quite successful in helping with on-farm development. But in dealing with problems of water distribution, maintenance, norm enforcement, etc. success was uneven. They were not well enough organized to take up responsibilities that members as individuals were quite willing to perform. For example, a maintenance fund could not be collected. Group interest in repairs could not find expression. And the reasons are not difficult to find. The implementation teams were always under pressure to move on to new areas, chasing targets which required them to put in long hours of work. They never had the time to work with pipe committees even for one full irrigation season (five months). There was no organization or personnel to provide back-up support. The services of the T&V (Travel and Visit) staff were available only for short periods. The arrangement to put one field worker to supervise some five pipe commands (150 ha) was abandoned after the first year because of lack of funds. While the necessity to keep the committees active was continually felt, effective measures could not be adopted. Whatever success came by way of Chak management was due to the initial interest of the project authorities and the motivational context provided by the situation - availability of water and prospects of good yields.

4.1 Factors in Viability

What factors contribute to viability, that is, make the pipe committees self-sustaining? Four seem particularly important. First, the contribution of the project authorities, particularly the irrigation department. The main function of pipe committees is to deal with water. The irrigation engineer who creates irrigation resources and manages a large system to deliver specified quantities at remote outlets has the most important contribution to make. Chak supplies depend totally on main systems operation. On-farm development is necessary for getting water to all parts of an outlet command. But it is only a means for transporting water. The success with which farmers manage irrigation depends on the dependability with which water is delivered. It was largely the practical wisdom of a project administrator to have recognized the crucial role of the irrigation department and to have build it into the functioning of the authority. Wisdom, however, does not always bring success. Pochampad could be considered an excellent exception. And here lies its vulnerability. It is not realistic to expect an unusual combination of officers, from the state level down to the project, to materialize too often. Should the officers leave, as many have by now, or if one of them had left in the early stages of the programme, the results might have been quite different. A system with general applicability has to be developed. The chief elements of this system, as Pochampad has shown, are the active involvement of the irrigation department, interdepartmental cooperative action and a problem-solving approach to difficulties faced by farmers.

Secondly, the development of management capabilities was important. The Pochampad experience shows that the irrigation associations can make a useful contribution and that farmers are motivated. But suitable norms, linkages and management capabilities have to be developed. For this irrigation associations require guidance and stability. Two observations are important. First, there should be sufficient water in a command where farmers' associations are to be created. Acute scarcities are likely to erode self-discipline and also the motivation to work in a group. This is not to say that pipe committees cannot face water shortages. One year when water supply was deficient, farmers cooperated with the project authority and were able to raise good crops. There were hardships but discipline was maintained. Upstream villagers and farmers drew more water. But this did not exceed the tolerance limits of the farmers' organizations. Some ceased to function but they did not become defunct. The social system that a pipe committee represents withstood the strain imposed upon it because the Chak system and the main canal system were viewed as one and the project authorities and the farmers addressed themselves to problems <u>together</u> rather than each going its own way. Secondly, the administrative units that implement a system of water rotation and set up pipe committees cannot sustain them. They are on the move to other areas. Additional trained manpower is required to follow up the committees. This does not mean that a new cadre

needs to be recruited for assisting the development of pipe committees. In fact, low cost solutions are available and they may work even better. For instance, the agriculture extension officers under the T&V programme occasionally assisted pipe committees but never over a long period of time since their involvement was disapproved of at higher levels of government. However, it is logical to combine irrigation extension with agriculture extension. The T&V staff has enough time to convene meetings of pipe committees. Many members of the irrigation association are likely to be "contact" farmers. Additional suport can be given by employing the field staff of the irrigation department who exist in fairly large numbers in the canal systems in north India but whose ranks have to be augmented in southern states for other reasons such as shift to dry irrigated cropping in areas that should not be under paddy.

The third contributor to viability is the social legitimacy of pipe committees. Being artificial in the sense that they do not fit or follow any of the existing social institutions of a community, they have to sink their own roots. It will be recalled that irrigation problems were often referred to one of the recognized village leaders, some of whom were not committee members and, in a few cases, to the caste Panchayat. Farmers' associations can acquire legitimacy as social organizations when their utility has been demonstrated to justify a base in the existing institutional framework of the community. Some social integration seems to have been occurring in Pochampad. It was observed that Ramajipet, a more cohesive village, was quite hospitable to its irrigation associations while Narsingapur was somewhat indifferent although the pipe presidents in both villages were quite keen to keep the committees active. Legal authority can give legitimacy. But even then the association has to create a place for itself - for legal authority may not be used or may be abused. In the formative years, therefore, care has to be taken to emphasize the importance of the new irrigation association. Frequent meetings, discussion of common problems, involvement of prominent villagers as observers, appropriate training and full backing of the administration should help the committees gain recognition as legitimate social institutions.

The fourth factor suggested by the Pochampad experience but not tried out there is the need for a high level committee of members representing farmers on a minor or distributary. Such a committee can work jointly with the administration to tackle unauthorized use of water in the upper reaches, refer field-level problems to the appropriate level of government and return to farmers with acceptable solutions. Its function is similar to that performed by communal irrigation systems, namely, the procurement of water. But its responsibility is not just to farmers located in one or two Chaks but to all those who are serviced by the subsystem. Canal systems are expected to deliver assured irrigation according to design assumptions. But this rarely happens in reality. A high-level irrigation association can perform this very important function which canal authorities have generally failed to do on their own and which is an important factor in enhancing the farmers' capacity to deal with the Chak system. Such associations are particularly relevant for the low intensity systems of north India that have a perpetual tail end problem. It is almost impossible for any form of people's participation to survive in such systems. Even the rather mechanical Warabandi system often fails because water supply decreases progressively towards the tail end.[1] The employment of irrigation guards on some southern canal systems serves this very purpose.[2]

The Pochampad experience holds outs a promise. Irrigation associations can be set up in large irrigation projects and they can carry out the functions expected of them. It also bears testimony to the enormous capability of government officers to formulate and implement ideas on the sheer strength of personal conviction and the ability to learn in the process of programme implementation. But there is still a considerable gap between what is known and what is required to be known before an acceptable strategy for large-scale implementation can be recommended. As in the case of irrigation, the potential is there. Its utilization is the problem.

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INVOLVEMENT OF FARMERS IN WATER MANAGEMENT IN GAL OYA, SRI LANKA

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[1] The author was the chairman of the Water Management Research Group at the Agrarian Research and Training Institute (ARTI) and also the coordinator of the programme described in this paper from its inception until January 1983. However, the ideas and opinions expressed are the author's and do not represent the official views of ARTI.

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1. INTRODUCTION

1.1 General

In Sri Lanka, the easiest and cheapest sources of irrigation are already in use, and as a consequence irrigation water is becoming increasingly scarce. Solutions to the water problem therefore involve new approaches, including changes in the formal and informal institutional structures.

A major (irrigation) rehabilitation effort by the United States Agency for International Development (USAID) and the Government of Sri Lanka (GSL) had recognized this fact and, consequently, both physical rehabilitation and the establishment of farmer organizations for better water management were provided for in the project. This paper examines new procedures and institutional arrangements which could lead to better performance in water management.

1.2 The Production Environment

Sri Lanka is divided into two major climatological regions: the dry zone and the wet zone. The dry zone receives a highly variable, basically bimodal rainfall distribution.[1] Consequently, two distinct crop seasons, namely Maha and Yala, can be seen.[2] Rice, the major crop in the domestic sector, is grown under irrigated (mainly in the dry zone) as well as under rainfed conditions. The rainfed rice in the dry zone is essentially limited to the Maha season. Rice accounts for about 45 percent of per capita calories and 40 percent of per capita protein in the average Sri Lankan diet and provides employment to about 40 percent of the agricultural work force. In effect, efforts to develop infrastructures related to irrigation water resources are associated with the dry zone and are focussed on paddy cultivation.

1.3 Irrigation Development in Sri Lanka

"So careful were the inhabitants in husbanding the liquid resources on which their very existence depended, that even the surplus waters from one tank which would spill when water was plentiful were not allowed to escape. The tanks were built in orderly method at slightly varying elevations so that there often was a series of reservoirs to take the overflow from the one above it. The exit of water was regulated by means of sluices to the rice fields." (Broheir 1934).[3]

As Broheir commented, Sri Lanka had a strong tradition of tank irrigation using an elaborate network of channels, and the historical evidence shows that from about the 5th century to the 15th, irrigation activities played a crucial role in sustaining the ancient empires. However, for reasons yet unclear, the great hydraulic civilization began to fade away at the end of the 13th century (Indrapala 1971).[4] The dry zone became depopulated.

Serious state interest in reviving domestic agriculture through development of the dry zone began to appear only at the beginning of this century. Since the establishment of the Irrigation Department (ID) in 1900, the development of irrigation infrastructure has received high priority in development strategies. Lack of irrigation has been identified as the major constraint to cultivating land in the dry zone and thus the main objective was to develop as many irrigation reservoirs as possible. Therefore, the ID was primarily meant for investigation, design and construction activities. Irrigation-based colonization projects in the dry zone began with the Land Development Ordinance of 1935. Irrigation infrastructure development absorbed a major share of development budgets during the recent past. Construction of a huge river diversion project, the Mahaweli, is now in progress, and it is expected that this will increase the irrigable land in the country by about 360 000 ha.

2. THE GAL OYA PROJECT

2.1 Background Information

Apart from the Mahaweli Project, the Gal Oya Irrigation Scheme is the largest in Sri Lanka. It covers a geographical area of about 1550 km² and produces nearly 9 percent of the

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[1] The rainfall isoquant of 1900 mm/annum is the boundary between them.

[2] Maha is the major season, also called the wet season, from October to January, and Yala is the dry season associated with minor rains occurring from late March to May.

[3] Brohier R.L. (1934) Ancient Irrigation Works in Ceylon. Government Press, Colombo.

[4] Indrapala K. (ed.). (1971) The Collapse of the Rajarata Civilization in Ceylon and the Drift to the Southwest. University of Ceylon, Peradeniya.

country's total paddy. The project commenced with the building of the main dam across the Gal Oya River at Inginiyagala in 1948. The capacity of the main reservoir of the Gal Oya System is 950 million m^3 at full supply, and was designed to provide irrigation for about 48 600 ha with the Left Bank channels serving nearly half this amount (see Figures 1 and 2). The Left Bank's actual command area is presently at least 50 percent higher than the planned command area, mainly because of unauthorized cultivation since the inception of the project. The Gal Oya Left Bank System, on which this paper is focussed, is estimated to be composed of nearly 52 km of main canals, 145 km of major distributaries, 445 km of minor distributaries and approximately 685 km of field channels. The Left Bank drainage is directly into the ocean and the lagoon area (see Figure 2). The Gal Oya catchment, which covers nearly 1800 km^2, receives an average of about 327 mm of rainfall spread over about 100 days, of which nearly 70 percent comes during the northeast monsoon period, October to February.

The ID had been involved in the original formulation of the project and in the construction of the channel system. The earthen dam, concrete spillway and the powerhouse were constructed by a foreign company. The scheme was run by an autonomous body, the Gal Oya Development Board, from late 1949 to early 1961. In 1961, however, the administration of the system had been handed over to the Government Agent of the district. The ID, however, remained for operation and maintenance activities.

As a multipurpose scheme, the objectives of the project included flood control, generation of electricity and provision of treated drinking water. In a directive issued in 1949 the government announced that "the Gal Oya Development Board should constantly bear in mind that the principal object of the scheme is the establishment within its area of authority of the maximum number of families of Ceylon citizens that the area can carry at a reasonable standard of good and comfortable living conditions". From the early 1950s the Board commenced the setting up of a large number of colonization units on the Left Bank. Forty of these units consist of approximately 6000 households. Besides these, there are two government farms and some private land on the Left Bank.

2.2 The Water Management Project

Because of the serious deterioration of the physical system with silted channels, broken structures, and inadequate water distribution, in 1978 the Left Bank area of the Gal Oya Scheme was chosen for a major rehabilitation effort by USAID and the Government of Sri Lanka. Recognizing that restoration of the physical system alone would not make for any lasting gains in productivity and welfare, the main purpose of the project was to improve water management. The project began in late 1979 and is still in progress. The ID is the implementing agency. Socio-economic research - including project impact assessments and pilot testing of organizational processes to ensure increased farmer participation - is conducted by the Agrarian Research and Training Institute (ARTI). The Rural Development Committee of Cornell University, USA, having a cooperative agreement with USAID, provides consulting services in support of ARTI's research programme. This showed that the water management problems in the project area were far greater than envisaged by those who formulated the original project.

2.3 Irrigation Management Problems

Inequitable distribution of water was prevalent throughout the Left Bank area. Water schedules decided on at the cultivation meetings were not adhered to, and instead of periodic issues of water, some of the head areas were provided with a continuous supply while certain areas in the tail end never received water at all, especially in the dry season. Inadequacy and unreliability increased sharply towards the tail end of the main distributory canals, and to a lesser degree towards the tail end of lengthy field channels. At the same time, drainage problems were observed in upper portions of the system where over-irrigation occurs, and in portions of the tail where losses from this accumulate.

Reconnaissance surveys had provided ample evidence of lack of user participation in operation and maintenance activities in the Gal Oya Left Bank. In general, most of the farmers displayed a lack of confidence in government officers of the area. Farmers felt that officers did not appreciate or attempt to understand the gravity of the problems faced by farmers. Secondly, they felt that officers did not do everything within their power to bring relief to the farmers; rather they tended to take the path of least resistance. An important finding was that farmers generally viewed the problems of the system fairly objec-

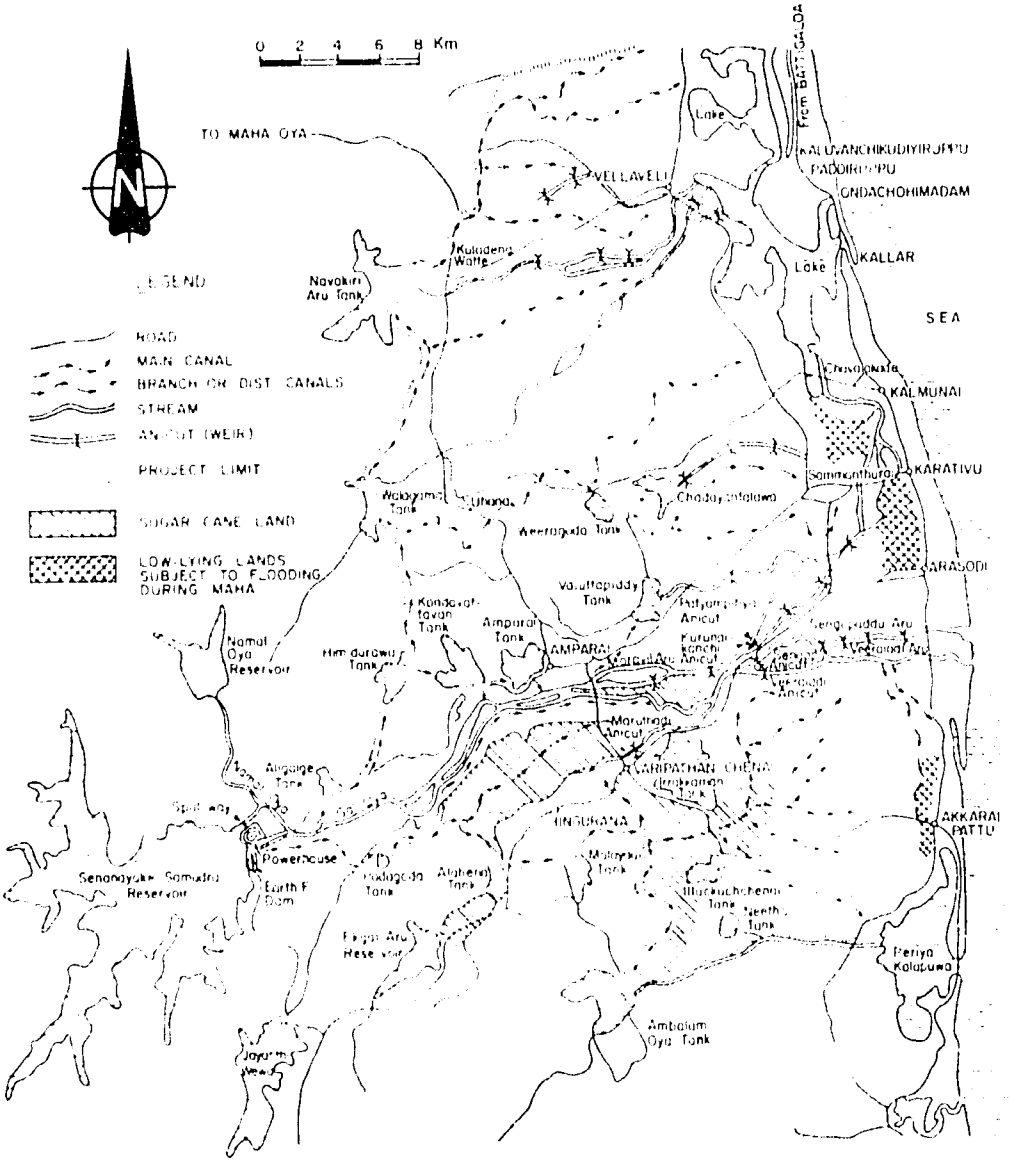
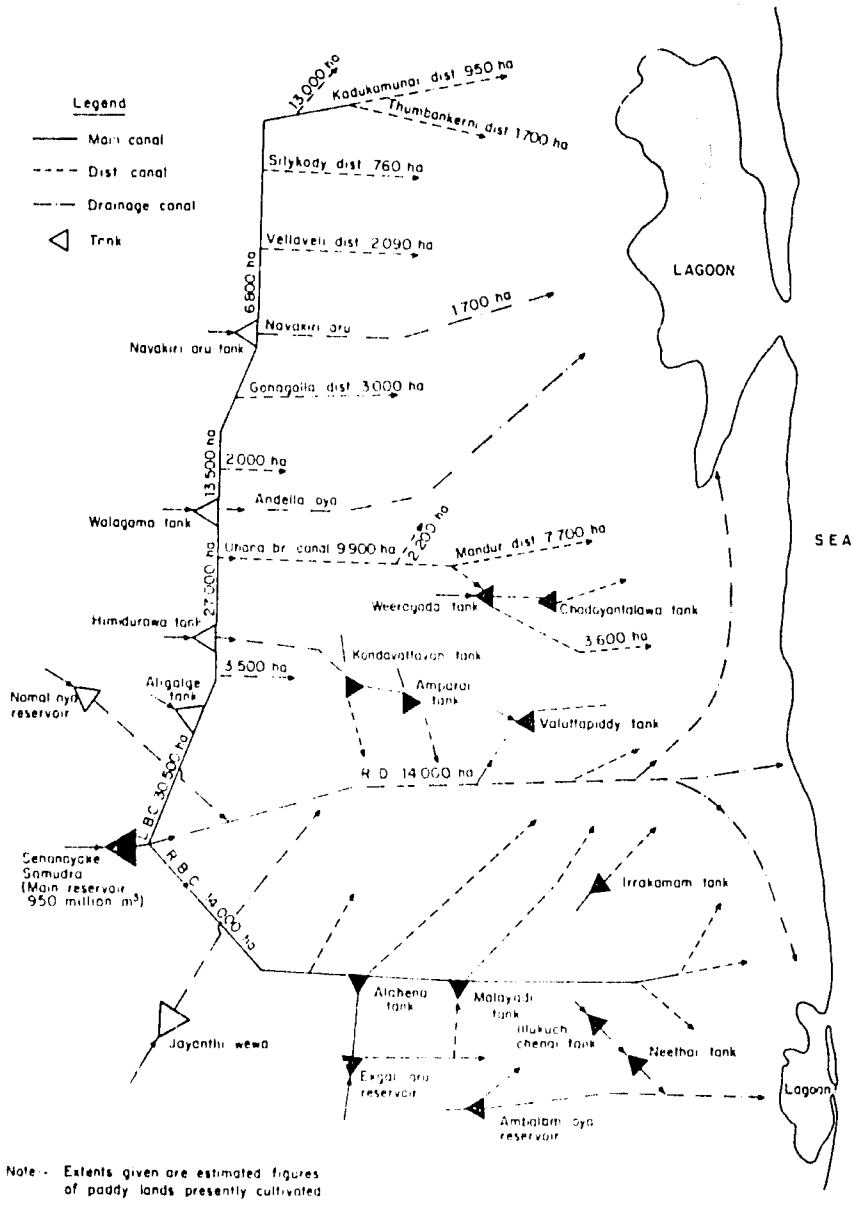


Fig. 1 Gal Oya Project layout



Note - Extents given are estimated figures of paddy lands presently cultivated

Fig. 2 Gal Oya Project line schematic

tively. They not only saw the shortcomings of officers, but identified their own weaknesses too. In addition it was found that communication between different categories of officers within ID and between ID staff and farmers was poor. For instance, in the baseline surve farmers were asked whether they knew the following officers: (i) Jalapalaka (lowest level ID officer), (ii) Maintenance Overseer (officer next to Jalapalaka in the ID hierarchy), (iii) Technical assistant (next to Irrigation Engineer) and (iv) Cultivation Officer of the Department of Agrarian Services. In a second question, farmers were asked how often they had met with each of these officers for official purposes during the preceding wet and dry seasons. A breakdown of the response is given in Table 1.

Table 1 CONTACT WITH FIELD STAFF, PERCENTAGE OF FARMERS INDICATING THEY KNEW THE RESPECTIVE OFFICERS AND PERCENTAGE REPORTING TWO OR MORE VISITS WITH OFFICERS DURING PRECEDING MAHA AND YALA SEASONS

Officers	Know Officers	Farmers reporting Two or more visits in Maha	Two or more visits in Yala
Jala Palaka (irrigation)	61	9	7
Maintenance Overseer	50	7	4
TA	49	8	6
Cultivation Officer	84	31	18

2.4 Scope for Planned Intervention

The need for participation of farmers in irrigation management was evident from this analysis of system performance. Farmers' lack of confidence and lack of desire to organize may be mainly due to unreliability of water supply and lack of initiative by ID or any agency. Lessons were also drawn from past experience in organizational approaches to water management. Since independence, Sri Lanka has had a variety of institutions for water management. In the early post-independence era, the institution of Vel-Vidane (Irrigation Headman), established during the British colonial period, was continued. Vel-Vidane was appointed by the Provincial agent of the central government and was given power and authority to execute decisions for the proper maintenance and operation of the minor irrigation scheme in his area of authority.

In the late 1950s, the institution of Vel-Vidane gave way to an elected committee of farmers known as the Cultivation Committee (CC). These institutions had to deal with other functions as well. In the early 1970s, Agricultural Productivity Committees were established to oversee the work of the CCs. Later Agricultural Productivity Committees were abolished and a new institution known as the Agrarian Service Committee (ASC) was established. In the baseline survey, farmer opinion on these various approaches was ascertained. It was evident from this analysis that a major drawback in the past was that the target group or the beneficiaries were not involved in the planning, implementation and evaluation of those processes. Instead we usually adopted a "top-down" approach.

2.5 Problems Faced by the Engineers

Engineers, too, have little scope to get a consensus agreement on their work, mainly because:

a. there is no well articulated network of user groups at different various levels to monitor and follow-up the schedules decided on at seasonal cultivation meetings;

b. powerful farmers used to call upon politicians to interfere and wreck the agreed schedules;

c. O&M budgets are inadequate and there are insufficient qualified staff;

d. there is lack of incentives and rewards for good work;

e. problems stem from system design: it is nearly impossible to achieve an equitable distribution from a project that was not originally designed for equity - this is evident from the complexity of channel network and gross inadequacy of control structures;

f. there is a disparity between planned and actual command area.

However, it was assumed that the physical rehabilitation would take care of most of the major drawbacks in physical structures, provided that farmers were consulted at the design stage. This opportunity was considered to be of immense value in mobilizing local skills to improve system performance.

3. STRATEGIES TO INVOLVE FARMERS

3.1 Introduction

The ARTI research group decided to evolve a methodology that would stimulate the evolution of organizations by farmers themselves. This approach attempted to promote people's association and cooperation with each other, using methods and rules of their own choosing, so that people would come to regard the organizations developed as their own. The methodology required potential members to develop their perceptions of problems and needs, and then begin a process of exploring how these needs could be met. In effect, what had to be done was to make a planned intervention into the community, strong enough to catalyse the internal dynamism of the community and controlled enough not to dominate it. This intervention was made through a catalyst agent called an "Institutional Organizer" (IO).

3.2 The Role of the Institutional Organizer

The most significant feature was that the IO entered the community with a trained but open mind. He did not take with him a model organization. He did not have a ready-made organizational structure, complete with constitution, byelaws, qualifications for membership, objectives, functions, sanctions for transgressions, etc. His objective was 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 officers would attempt to develop participatory organizations for water management.

An IO should respect people, their ideas, values and beliefs. He must have faith and confidence in people and trust in their ability to define and contribute to the solution of local problems. An IO is neither an instructor nor an educator in the classic sense. He is a facilitator. He promotes interaction between farmers. He encourages the development of a group consciousness among them. He helps farmer groups and government agencies interact with each other, based on mutual respect. His role is to make farmers self-reliant. He is a catalyst. He does not made decisions for people but helps them analyse issues, always leaving the decision making to them. For instance, in regard to the formation of farmer groups, he only promotes the concept, but leaves decision-making about the form, structure, membership, rules, etc. of the organization to the people.

3.3 Recruitment of IOs

Graduates (male and female) in social sciences, agriculture and development studies having at least two of the following qualifications were invited to apply:

- personal experience in paddy farming;
- experience in the dry zone (people who had worked or lived in the dry zone for a considerable period);
- past participation in village organizations;
- ability and willingness to live and work with rural people in remote areas.

The ARTI administration managed to avoid political influences during recruitment. More than 70 percent of the successful candidates were sons or daughters of small farmers. These qualifications helped them to:

- win the confidence of farmers;
- grasp quickly the problems and prospects for farmer organizations in a specific area; and
- live and work hard under difficult conditions, both physical and mental.

3.4 Training

After recruitment, IOs underwent pre-service training for six weeks. During the first two weeks, trainees were exposed to the concepts and methodology of the "locality-specific approach" techniques of organization, communication and working with groups. Lectures, discussions, role-playing games and exercises were used to present concepts and ideas and to develop requisite skills.

The last four weeks were devoted to field training in the project area and

the participants were provided with practical on-the-job training the methodology of promoting p ple's participation by working in partnership with farmers. The main stages of the methodology are to:

- learn how to enter in to the community;
- establish rapport and win farmer confidence;
- familiarize themselves with the social and physical environment of the village;
- study farmer problems and needs as well as issues in irrigated agriculture; and
- establish the process of dialogue for problem identification and solution.

While familiarizing themselves with the main problems, trainees gained valuable practical experience in usin the above methodology in a face-to-face working relationship with farmers and government officers. For this activity, trainees were divided into four groups. Each group was assigned to work in a single colony village, reviewing major problems faced by the community in relation to agriculture, irrigation, land tenure and community organization. Although the study of problems in these four areas was important in itself, the training strategy was to use this as a convenient medium to provide practical experience to the trainees in working with farmers.

3.5 Fielding of IOs: Team Approach

Thirty IOs were appointed for organizational work in March 1981 in two different areas of the Gal Oya Left Bank. The total area covered by their pilot effort was 2227 ha and comprised 1686 farmers and 71 field channels. Second, third and fourth batches of IOs were fielded in September 1982, March 1983 and October 1983 respectively. At this stage the programme covered an area of about 7500 ha (see Figure 3 for locations).

The IOs were fielded in teams of about 4-7 in each, the exact number depending on the hydrological boundaries and the number of farmers served by the given irrigation unit. Each IO was assigned to a specific hydrological unit. Initially, the farmer:IO ratio was about 60-100 but this was allowed to increase as experience was gained. Although each IO was personally responsible for the assigned area, the group as a whole was responsible for the overall area assigned to it for organization. All IOs work as a tight-knit group and help each other in identifying and solving problems. An IO selected by consensus acts as the coordinator of each group. The team approach has added advantages. For example, whenever an IO is not available for some scheduled work his team mate could attend on his/her behalf. Finally, a female IO could seek cooperation of her team-mates in difficult work or when working late hours.

3.6 Process Documentation

It was recognized that some mistakes would be made while learning about farmers' perspectives and trying out promising approaches to secure effective participation. Equally important is that errors be quickly identified and adjustments or changes made in the programme based upon lessons learned. The learning component was initially incorporated mainly through a process monitoring programme, using participant observation as its main tool. Process documenters (PD, selected from IOs) observed and reported the social dynamics generated as a result of the intervention process undertaken by the IOs. Process documentation attempted a continuous evaluative assessment of the field organizing activity with implementing staff leading to an analysis of the organizational process - its defects, strengths, leading problems and potential solutions.

The overall supervision and administration of the programme at the project level was assigned to a senior officer, assisted by the IO Project Coordinator (IOPC). The IOPC was selected by ARTI administration (in consultation with the ID) from a group of IOs nominated by their colleagues. At ARTI head office, a research officer appointed by the research team was personally responsible for coordinating the programme, while the group as a whole was reponsible for the overall project.

Field organization of the programme is illustrated in Figure 4.

3.7 Learning About the Area of Operation

An IO entering the target community was expected to get acquainted with his/her own area of operation. More specifically, this phase was designed to provide an understanding of:

a. geography, location, climate and soils, etc.;

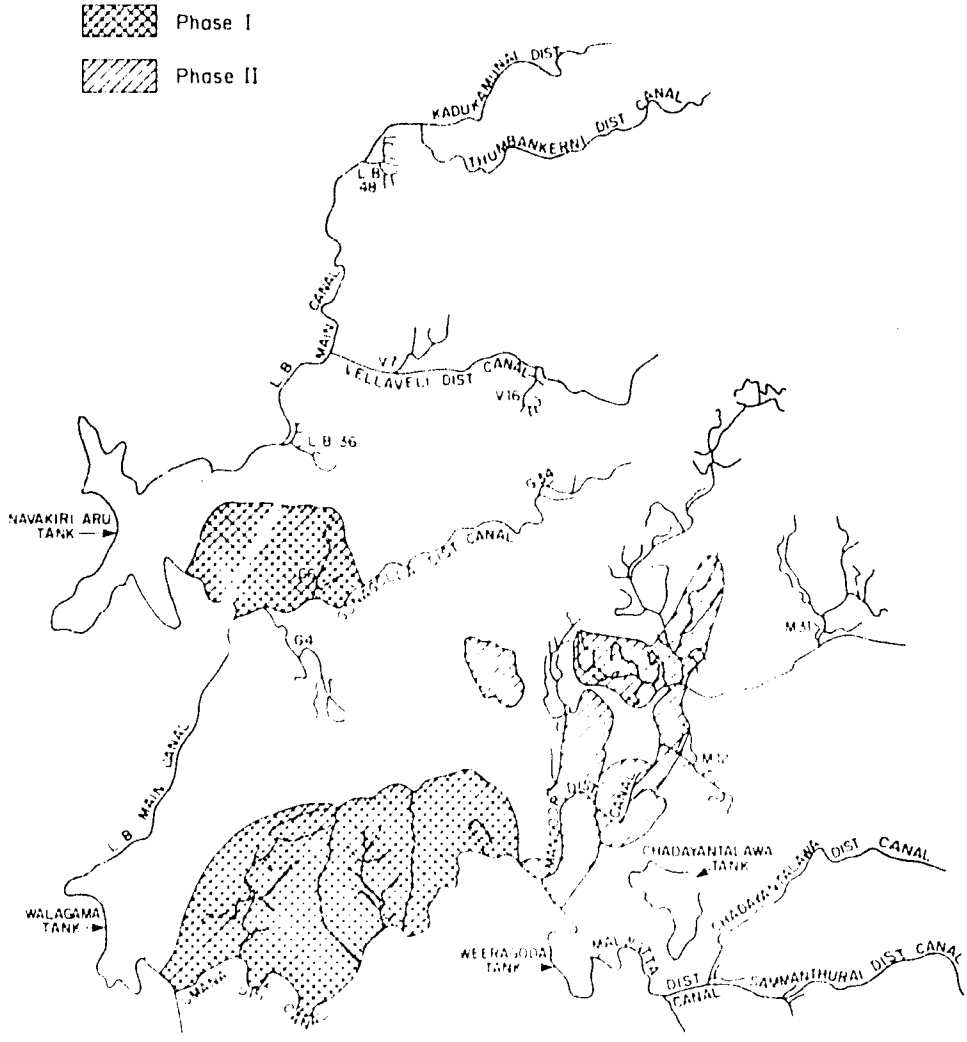


Fig. 3 Location of pilot areas

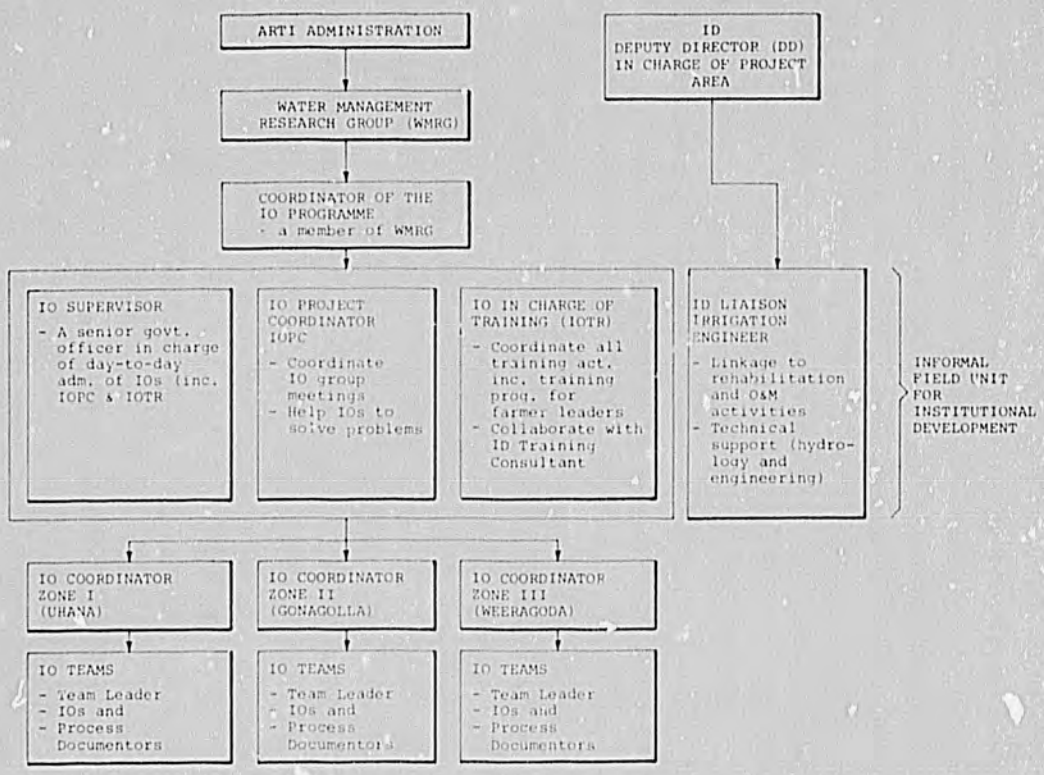


Fig. 4 Field organization of IO activity

b. socio-cultural aspects; formal and informal organizations and leadership patterns in the community;

c. economic factors; economic institutions, major occupations, income levels, agriculture, family budgeting, credit, marketing, etc.;

d. political factors: political structure, political party identification, political factors in community organization, influence of party politics in water management; and

e. administrative infrastructure: administrative organizations at different levels, efficiency or coordination between these levels, overlapping jurisdictions, etc.

Each IO was then expected to prepare four different "profiles", namely irrigation and water management, community organization, land and land tenure, and agriculture.

3.8 The Formation of Farmer Groups: Role of the IO as a Facilitator

After the initial phase of learning about the area of operation, an IO was expected to assist the farmers in a common field channel (the lowest hydrologically defined area), usually 10-20 farmers, to meet together and discuss the importance of self-reliance and group action. In this process, the IOs helped farmers to arrive at sound decisions, encouraged problem solving by, facilitated unity and cooperation among farmers, helped farmers assume responsibility and leadership in the solution of community problems, motivated farmers towards more equitable distribution of water, helped farmers to overcome unscientific and irrational practices and techniques regarding water management.

This process was initiated through discussions with individual farmers, then with informal groups. Ultimately formal organizations were established at the field channel level, with the broad objective of improved operation and maintenance, reduced conflicts,

and better interaction with ID. By consensus, the group selected one of the member farmers as the Farmer Representative. The Farmer Representative does not play an authoritative role; instead he is the spokesman of the group who takes part in monthly meetings with officials. He also convenes group meetings and performs a coordinating function. This is not a permanent position and in some groups rotations have already occurred. In other groups, farmers have changed their representative because of inefficiency or lack of confidence.

4. PROGRESS

4.1 Farmer Participation in Operation and Maintenance

The severe water shortage experienced during the 1981 dry season provided an opportunity for the IOs to attempt to mobilize farmer skills in managing water in their own field channels and especially in instituting water saving measures. Rotational distribution within field channels, water saving by reducing draw-offs from the distributary channel to the field channel and cleaning of field channels through voluntary labour were the three main activities through which attempts were made to use the skill, knowledge and ingenuity of farmers for operation and maintenance at the local level. After discussing pros and cons of the various activities, farmers were free to take any decision regarding adoption/non-adoption. These impovements in water management have continued ever since and at present almost all the field channel level farmer groups are adopting rotational distributions, water-saving techniques and participate in maintenance activities following group mechanisms.

In a survey conducted by the water management research group in April 1983, 73 percent of the groups reported that they had instituted rotations for the 1982 Yala season while 82 percent of the groups were planning (at the time of the survey) to institute rotations for the 1983 Yala season. Therefore it could be claimed that the mobilization of farmers' skills during the 1981 drought had furnished the necessary "ground work" for the process of institutionalization of farmer organizations in Gal Oya. During this season, out of a total of 71 channels, 35 adopted rotations, 22 adopted water-saving measures and 16 adopted both rotations and water-saving measures. In most cases, farmers adopted "tail-end-first" rotations. In about 10 percent of the cases, however, rotation was discontinued due to non-cooperation and intervention by farmers who rely on drainage water for their irrigation, which was reduced by the water-saving techniques.

The general schedule of irrigation issues for the season in question was annunced in advance to be "five days on - five days off". Farmer groups of 38 channels (out of a total of 71), however, voluntarily restricted their own quota by 1-3 days, thus saving water in the distributary channel so as to assist downstream farmers. According to farmers themselves, systematic water saving as was practised by 58 percent of the farmers in the pilot area could really be termed an innovation in the Gal Oya scheme.

4.2 Voluntary Labour for Channel Maintenance

In Yala 1981, the very first season of IO intervention, a little over 15 km of channels were desilted and cleaned for which 628 man days were contributed by the farmers on a Shramadana[1] basis. In addition, minor repairs and maintenance work such as cleaning small tanks and repairing concrete pipe outlets were accomplished during this period. Most of these channels had not been properly maintained for 15-20 years.

In a survey conducted in April 1983, 71 percent of farmer groups reported cleaning all parts of their channels by Shramadana since the formation of farmer organizations, while only 23 percent reporting using Shramadana labour even once during the preceeding 30 years. The same survey revealed that 54 percent of all maintenance activities other than channel cleaning were performed by Shramadana labour. In some cases IDs assisted farmers' efforts by providing cement and technical advice. Shramadana labour was also used for building check structures, repairing bunds and roads, etc. It should be noted that the responsibility of this work lies with IDs and not with farmers.

4.3 Mobilizing Farmer Knowledge for Design and Construction

After thirty years of farming in the Gal Oya valley, farmers there have built up substantial knowledge of agriculture and irrigation. This is immensely valuable for redesigning the

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[1] Shramadana is a traditional method of mobilizing labour for community work in rural Sri Lanka.

tertiaries, especially as the Gal Oya system has changed considerably over a period of 30 years. New lands have been brought under cultivation. The channel network, especially the tertiaries, have been realigned to some extent by farmers and the farming practices have been adapted to suit the existing water supply situation. This exercise helped farmers identify with the system and provided an equally important learning experience for the ID officials working collaboratively with farmers.

The IOs assisted farmers and the ID to meet together to discuss field channel redesign. IOs first introduced the idea to farmers (in a particular field channel) individually. They were requested to give thought to specific system problems and needs in their areas, suggestions for solutions and recommendations for future operational management policies. Farmers were also requested by IOs to discuss these problems informally with one another, in small groups, so that they could obtain a better perspective of the common problems in the area.

Subsequently, due to staff and time constraints, a single "walk-the-channel meeting" was substituted for the elaborate design meeting procedure. An engineer, assisted by a technical assistant, met with the farmers on a particular field channel by prior appointment to discuss the proposed design for the field channel. Irrigation staff and the farmers discussed possible problems and solutions while walking along the channel. At the conclusion of the meeting an agreement was signed between the farmer representative and the irrigation engineer, setting out each other's responsibility in channel redesign and rehabilitation. It was the responsibility of the farmers to do the greater part of earth work at field channel level while the ID is responsible for repairing and constructing all concrete structures, installing outlets, etc.

4.4 Linkages

Active participation in operation and maintenance activities such as water saving and repair are indicative of improved interaction among the users. Thus it is evident that the IOs have made a successful effort in promoting a sense of unity and cooperation, and when called upon have shown a willingness to support these ideas with action. They have recognized the promotion of farmer unity as one purpose of the farmer organization.

In addition, the farmer organization programme appeared to develop a sense of responsibility among the farmers for the system. While creating a consciousness among the farmers about their identity, the IOs also attempted to increase farmer responsibility for their irrigation system. In the pilot area, tampering with irrigation structures has been greatly minimized.

As cooperation among users improved, water disputes became less common. In the survey conducted in April 1983, 49 percent of the respondents had reported the existence of conflicts prior to the formation of farmer organizations but only 17 percent had reported them after the establishment of user groups. This was confirmed when ID officials reported a significant reduction in their involvement in conflict resolution since the formation of water user organizations. As mentioned elsewhere, the situation prior to the IO programme was discouraging, as it was not possible for the ID to satisfy all the uncoordinated and conflicting demands made by the farmers. In addition to the overall reduction of conflict, a systematic way of handling conflicts was also evolved with the establishment of the farmer organizations. Most of the disputes over water are first directed to the field channel level organizations for resolution, and only the unsolved ones are then submitted to D-channel level and upwards.

The following mechanisms helped direct and effective dialogue between the farmers and the ID staff:

i. design meetings between irrigation staff and farmers;

ii. walk-the-channel design meetings between farmers and staff ((i) was replaced by (ii));

iii. monthly meetings between farmer representatives and field level officers of ID, Agriculture Department, Agrarian Services Department, etc.;

iv. periodic meetings between farmer representatives and district level officers;

v. formal arrangements made through the IO sub-unit office of the ID project office for farmers to meet with ID officials;

vi. informal meetings between farmers and field level officers;

vii. farmer representation in the District Agricultural Committee.

Of these, the design meetings are useful mainly for incorporating farmer

input into the rehabilitation process. In the long run, however, the formal monthly meetings and farmer representation in the District Agricultural Committee are expected to be more useful than the rest. These in turn will promote farmer involvement in the management of the main system. In addition, because of the participation of officials of other departments related to agricultural production, these meetings have already created a forum for interaction between farmers and non-ID officials. One may expect that the activities of water user groups will ultimately spread to non-water aspects. This is important as the optimum productivity of irrigation is invariably associated with other complementary inputs.

Mechanisms evolved for promoting farmer-ID cooperation are indicative of a radical shift in their mutual perceptions. In the survey conducted in April 1983, 61 percent of the respondents felt that there had been a change for the better in the attitude of ID officials and 70 percent felt that the relationship between farmers and officers was better than before. Most of the ID officials interviewed by the research group also felt that there has been an improvement in the ID-farmer relationship. This is not surprising as all local level ID officials, farmer leaders and the IOs meet monthly at the ID office to review work done during the previous month. The group discusses the shortcomings and weaknesses and attempts to come up with feasible solutions. A variety of incidences to verify the fact that farmer-officer interaction is increasing can also be found in process documentation reports.

4.5 Towards a Federation of Field Channel Groups

The analysis of spatial distribution of water and crop yields ranked main system management as of higher importance than management at the tertiary level. It is appropriate to emphasize that unless the necessary steps are taken upstream, efforts to improve operation and maintenance at lower and farm levels will not yield the expected results and the farmers' motivation to contribute to efficient water management will be eroded. Federation will also enable farmer groups to reduce/resolve the possible conflicts between the groups. Despite the fact that the areas of operation of water user groups are based on hydrological boundaries, these hydrological units need not necessarily be independent entities. For instance, a decision taken by a "head-end" field channel group of a given main canal may be harmful to a "tail-end" group of the same canal. This may be socially unjustifiable, and may worsen water use efficiency in the total system.

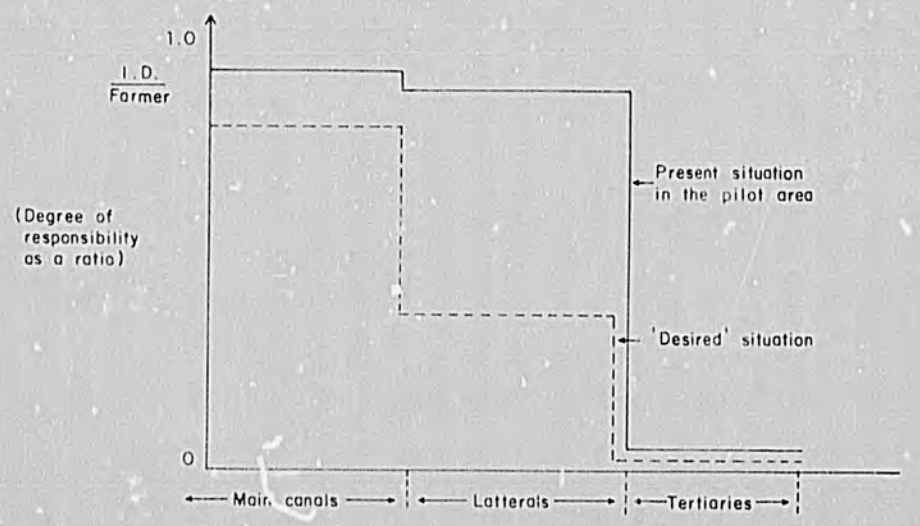

Fig. 5 (A hypothetical) division of responsibility between farmers and irrigation department

The problems and prospects of extending farmer organization to the distributary channel level were first discussed by the farmers at the field channel group level. Actual formation of D-channel level organizations was then started in an informal manner with coordination of irrigation rotations among field channels in a common distributary. Incorporation of these informal structures into formal bodies such as "standing committees" at different levels is in progress.

In addition, the farmer participation in periodic meetings with officers at regional and district level can be regarded as a positive response to farmers' managerial skill in respect of system management at higher levels.

However, the specific roles of ID and farmers at different levels of system management and the division of responsibilities between them are not well defined. The scale and complexity of the system will necessarily call for a major role by ID at the highest level.

For instance in the "desired model", the ID contribution at the field level may be limited to technical advice to O&M activities when requested by the farmer groups. On the other hand, farmers can do no more than participate in major policy decisions at the highest level.

4.6 Cost Effectiveness and Replicability

Despite the improvement observed in the water status and paddy yields it is difficult to separate out the contribution of farmer organizations to this end. Careful monitoring for a longer period coupled with a meaningful evaluative analysis is necessary to accomplish this task. This is in progress at present.

The per hectare cost of the programme for 1982 was around Rs 15 (US$ 5.5) per year.[1] Thus the programme seems to be cost effective.

The lessons learned on positive response of farmers towards productive involvement in water management were not based on the injection of administrative and other inputs which make them incapable of extension elsewhere. However it is difficult to conclude that the project was an absolute success.

5. CONSTRAINTS

The promotion of the process of institutionalization of farmer involvement in water management in Gal Oya and extension of experience to similar conditions elsewhere has its constraints. Most are associated with main system management, bureaucratic procedures, land tenure and similar issues. A few critical issues will be raised.

5.1 Possible Outcome of a Real "Test" under Stressed Conditions

The viability of a federation of farmer groups has not yet been tested under system-wide stress, although severe drought in 1981 affected parts of the system.

What might happen if the whole system is put under stress? Assuming that efficient conditions exist for creating farmer groups and carrying out physical rehabilitation, how much more rainted and under-irrigated land might be brought under efficient irrigation? It seems certain that the supply of irrigation water is grossly inadequate to meet all potential demands for it in the area. Expected bahaviour patterns under stress can be inferred from Figure 6, which indicates the sensitivity of crops to water supply. It is obviously prudent for farmers to plan their irrigation in such a way as to ensure their crops have an abundance of water (point A in the figure). As can be seen, this is not detrimental to crop growth and the farmer may reap added advantages such as better weed control. Farms who practise this type of irrigation are over-irrigated. On the other hand, farms which are short of water may lie somewhere on the curve in the figure below point B. Farmer organizations are therefore likely to try to drive the over-irrigated farmers towards point B, and at the same time to improve water supply to underirrigated ones. This would produce a more equitable water distribution and reduce water conflicts. However, the savings made from over-irrigated areas may not be sufficient to satisfy needs elsewhere. If many farmers were to end up on the sub-optimal area of the curve, production would be significantly reduced and group efforts would have been of little avail.

5.2 Alternative Farming Systems?

Alternative strategies to solve the

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[1] This excludes the cost of expatriate consultants because this component of cost is not relevant in the context of extension of this experience elsewhere.

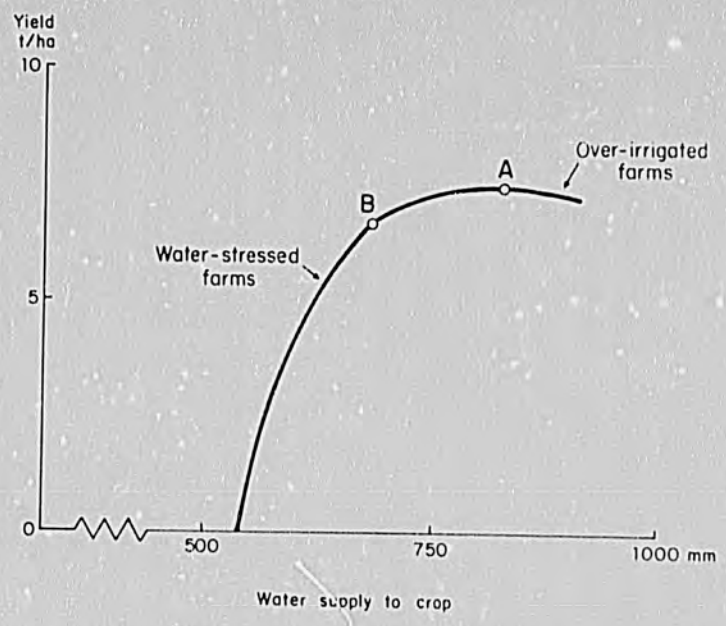

Fig. 6 Paddy yield response to water

problem of inadequate water supply are therefore required. In addition, the soils in some areas are too light in texture and too low in water retention capacity. Furthermore, the soil salinity, particularly in the lower regions, is a major problem that leads to abandonment of many allotments. Suitability of paddy in some areas in Gal Oya, especially for a dry season, is questionable. Thus exploring the potential of increasing benefits outside paddy farming seems imperative. Water-saving techniques such as minimum tillage, improvements in reuse, etc., should also be tried out. The lack of an efficient information system on water distribution and return flows may be an obstacle to this kind of progress. All these factors in turn may influence the process of institutionalization of farmer involvement in water management.

5.3 Different Perceptions of Participation by Different Participants

Different perceptions of participation by different participants of the project was evident especially at the beginning of the programme. Some members of the ID had originally viewed participation as a means of manipulation and regimentation - "farmers have deviated from official decisions, so get them to fall in line". Some of them viewed participation exclusively as a process of mobilization of labour for field channel restoration.

Gradually ID project staff became sensitive to the informational and management resources associated with the farmers and agreed to share knowledge and authority with them. Possible reasons for this change include:

a. Farmers had demonstrated their capacity to handle O&M activities including conflict management at local level so ID staff became willing to extend their cooperation.

b. The ID staff were pushed into that position by the contractual agreement between USAID and themselves, the ARTI/Cornell group and other senior officials (outside the ID).

c. Dedication, motivation and commitment of a few (senior) ID officials, especially at the project level.

Positive contributions of the ID were seen to be highly "personalized". This type of response was not confined to ID but was evident in other institutions as well. It should be noted that most officials including engineers belong to a distinct social group, considerably above the social status of the average farmer.

On the contrary, most of the IOs were from rural areas, and their background, education and experience must have helped them bridge the gap

between the two social groups - the farmers and officials. The contribution of the pre-service and in-service training they had undergone, their contacts with superiors, and the incentives provided to them towards this end has yet to be analysed.

5.4 The Need for Longer-term Commitments to More Fundamental Changes in the Organizational Structures

Government commitment is a key to this kind of programme. Within the broad confines of government policy, ARTI has reasonable autonomy. Although it is inappropriate to assume that the issues related to the continuation of user groups can be left entirely to the regular staff of the irrigation bureaucracy, it may not be logical to expect a research institute such as ARTI to handle the programme the way it does. However, positive steps towards enacting an adequate legal framework for water user organizations are not yet evident. An efficient and carefully designed legal framework to support the efforts of organized water users is essential in Sri Lanka where the procedures and structures of the decision making mechanisms in public service are oriented much more towards control than to innovative and creative work. For example, it may be necessary to provide farmer organizations with legal rights to participate and vote in the District Agricultural Committee, etc. At present, farmer participation in decision making at any given level is informal, depending on the "willingness" of the officials concerned.

To summarize, in areas where farmer groups are already established their long-term viability is restricted, mainly due to lack of "formal support" from the bureaucracy. The "support" so far received was seen to be personalized. But now that farmers have responded positively to this "bottom-up approach" of institution building, are we prepared to accept this position?

Second, in areas where water stress is acute, and tenurial conditions and similar issues are immensely complex, strategies for successful farmer participation have yet to be evolved. If farmer organizations in the initial phase are not successful there may be a negative "demonstration effect".

6. CONCLUSION

Most of the water user associations in Gal Oya are not "paper entities" but real organizations with viable operating structures and continuous records of performance of their functions. We say this because: (a) farmers provide information relating to design, operation and maintenance of their irrigation system, (b) they participate actively in O&M activities, (c) they also have the primary responsibility for conflict management, and (d) the ID is sensitive to the informational and managerial skills of the water users.

Farmer cooperation, the competence of the change agents and active support of a few members of ID staff were mainly responsible for this success. However, the continuation of active farmer involvement in water management in the Gal Oya project as well as its extension elsewhere under similar conditions are restricted due to lack of longer-term commitments to more fundamental changes in the organization structures which are essential in this respect.

INVOLVEMENT OF FARMERS IN WATER MANAGEMENT - ALTERNATIVE APPROACH AT MINIPE[1]

by

N.G.R. De Silva[2]

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[1] This paper is complementary to the paper "Involvement of farmers in water management in Gal Oya, Sri Lanka", by C.M. Wijayaratne. The author discusses the problems of water distribution in major irrigation projects in general and also presents a case study of the Minipe Project.

[2] The author was the Deputy Director of Irrigation in charge of the Kandy Range (within which the Minipe Irrigation Project is situated) from 1978 to 1981. Since then he has been serving as a Director of the Mahaweli Engineering & Construction Agency. The opinions expressed in this paper are the author's and do not necessarily represent the official view of the Irrigation Department of Sri Lanka.

1. INTRODUCTION

1.1 General

The supply of water in major irrigation projects is one of the vital factors affecting agricultural development in Sri Lanka. The principal feature of these projects is that large extents of state land are blocked out into parcels of about one hectare each and alloted to landless farmers brought into the project area from various other parts of the country. These lands are generally developed for double cropping with paddy. The irrigation system is designed and constructed to supply irrigation water individually to each of these small farms, and the water requirements of thousands of farmers have to be met simultaneously through a complicated system of main, distributory and field canals. All the individual farmers are inter-dependent on one another in that the system operates successfully only if each farmer behaves and cooperates in the way he is expected to. Thus, to ensure adequate water delivery to each farm, it is essential to have an appropriate system for the distribution of water and for the involvement of the individual farmers in deciding on and implementing schemes of water distribution.

It has been the experience in Sri Lanka that although there is a well-designed system for the delivery of irrigation water in every major irrigation project, the lack of proper strategies has caused serious difficulties in water distribution and subsequent deterioration of the component civil works. It has also resulted in unequal income generation between farmers within the same project and corresponding social problems. Further, the anticipated high returns from agricultural development within these projects have become hard to realize.

During the past few years there have been some attempts at mobilizing farmers to effect better distribution of water in major irrigation projects in Sri Lanka. This paper describes the approach adopted in one such project, the Minipe Project. Although there are some basic differences between the conditions at Minipe and at Gal Oya, there is also the underlying common factor of the use of a catalyst in triggering off the transformation process towards better and more scientific water management.[1]

[1] Described by C.M. Wijayaratne in his paper "Involvement of farmers in water management in Gal Oya, Sri Lanka".

1.2 Use of Water for Paddy

In Sri Lanka it is possible to have a successful cultivation with high-yielding varieties of paddy using irrigation water at the rate of 0.9 ha m/ha for "Maha" season (October-February) and 1.5 ha m/ha for "Yala" season (April-August). The "dry zone", where most of the major irrigation schemes are situated, gets most of its rainfall during the northeast monsoon in December and January. Hence, the amount of irrigation water required during this season is less than for the Yala season which receives a lesser amount of rain, from the southwest monsoon in April and May.

Major irrigation projects are generally designed based on the consumption rates given above but actual consumption in most schemes is much higher, generally about double the designed values. As a result of this excessive use of water, the full extents under irrigation schemes are often not cultivated. Further, even in areas cultivated, yields at tail ends of canals tend to be very low.

1.3 Reasons for Overuse of Water

Even if a very methodical plan is drawn up for the issue of water to individual farmers, its execution will depend upon numerous other factors besides water. Principally, the needs of all the farmers in the project as regards other inputs such as seed, fertilizer, credit and farm power should be available so as to enable each farmer to keep to the time schedule in the water issue plan. Unfortunately, various agencies are responsible for supplying these inputs and it becomes a problem to coordinate effectively the work of all these different agencies and their officials working at project level. For this and other reasons, many farmers may not keep to the time schedules required in the water-issue plan. The result can cause a complete breakdown in the distribution system which, in turn, means that most farmers, especially at tail ends of canals, would not receive irrigation supplies as planned. When farmers realize that there is no effective system by which they could expect their individual water requirements to be met, they resort to unauthorized methods of obtaining water, often at the expense of other farmers further down the canal.

Besides the problem of farmers taking water illegally, the greater wastage occurs by their using much more water than they require for cultivation. This is done mostly through fear of not receiving subsequent supplies

through the system. In the absence of a pre-arranged plan where supplies are assured to him, the farmer keeps diverting the maximum possible flow onto his field whenever he has the opportunity, legally or illegally. Such individual abuses of water far above actual requirements are one of the most serious causes of the colossal wastage of water that occurs in these projects.

1.4 Farmer Associations of the Past

The success of farm water management depends largely on the efficiency of farmers' associations. It is inevitable that the responsibility for water distribution at the terminal level is shared by these associations.

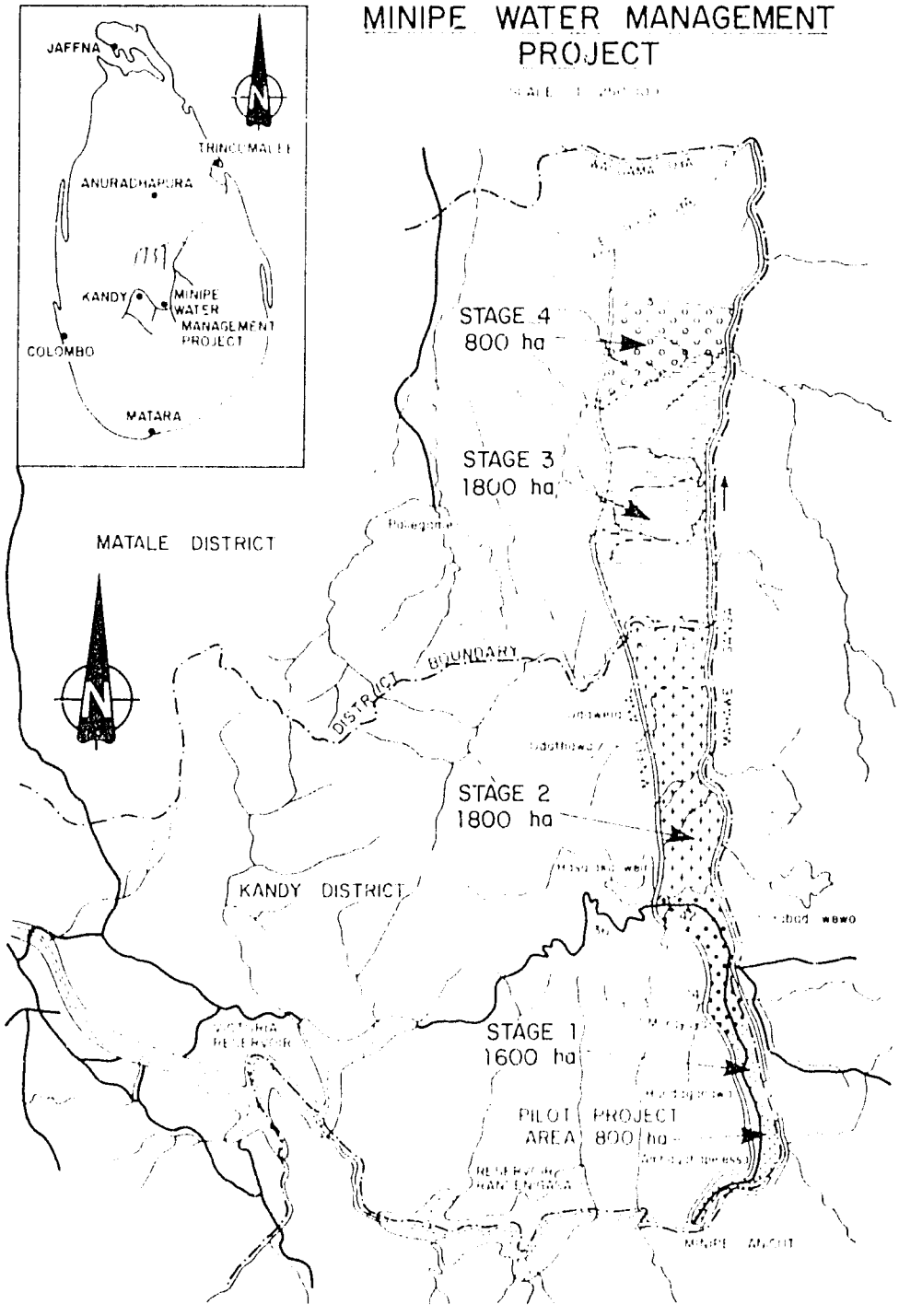
Since Independence, the first attempt to promote associations of farmers and to pass on leadership to the peasant paddy cultivators was through the introduction of "cultivation committees" set up under the Paddy Lands Act of 1958. This Act provided these committees, composed solely of elected farmer representatives, with powers to develop and maintain irrigation works within their area of operation. Traditionally, leadership in the village had been with the priests and with well-established families and the professional class which includes the village school teacher and the physician. As statutory provision was provided for cultivation committees to consist of qualified cultivators only, it was expected to make way for leadership to pass on to the real farmers. It was also expected that this process of democratization and uplifting of the status of the farmer would eventually lead to the growth of a responsible set of village leaders capable of stimulating the development effort of the farmers and setting the pace for increased productivity. This committee was also expected to serve as a body for planning and implementation of the agricultural programme in its area of operation.

Under the Paddy Lands Act, the cultivation committees were empowered to develop and maintain irrigation works within their areas and to exercise the powers of the former "Irrigation Headmen", a legacy of the colonial past. One of the important functions of the Irrigation Headmen had been to ensure that the annual maintenance work on irrigation bunds and channels was regularly performed by cultivators in order to keep the channels in proper working order. However, this system was found to be ineffective in many areas even prior to the introduction of the Paddy Lands Act. The cultivation committees also were generally ineffective in mobilizing farmers for effective maintenance operations.

In regard to the committees themselves, various factors inhibited their proper functioning as effective farmer organizations. Although it was the intention to offer leadership to the typical peasant paddy cultivators, the peasant farmer had been content to carry on his work without actively participating in the village level organization. The village financiers and landlords, who were not genuine cultivators, crept into the cultivation committees masquerading as cultivators. These people, though relatively small in number, were able to spread their tentacles of influence over all matters that came under the purview of these committees. These committees were also composed predominantly of the older farmers who were not adequately receptive to new ideas of scientific management of farms. Lack of sufficient youth participation was also a contributory factor to the lack of dynamism in these committees.

Another weakness of the cultivation committees was that they did not have adequate financial resources. Their main source of revenue was by the collection of an area levy. Collection of this levy never proved easy. Filing of action for non-payment of the levy was practically difficult as the members of the committee did not like to incur the displeasure of their relations and friends in their villages and become unpopular by such action. The members of these committees, although serving on a voluntary basis, were expected to perform all the statutory functions under the Paddy Lands Act and the Irrigation Ordinance. This ultimately proved to be only a hypothetical arrangement. The result was that the provisions of these Acts, which were vitally important to the proper functioning of irrigation systems and to farm water management, remained practically inoperative and ineffective.

Whilst the effectiveness of the system of cutivation committees was declining, government introduced the "Agrarian Service Act" in 1979 which invalidated these cultivation committees and provided for the establishment of "Agrarian Services Committees". These were composed of "appointed" members, a majority of whom were public officers. Out of a committee of 14 members, only 6 were to be owner cultivators (farmers). Farmer representatives have also been elected under the provisions of this Act but there is no effective organization of farmers that


MINIPE WATER MANAGEMENT PROJECT
JAFFNA
TRINCOMALEE
ANURADHAPURA
KANDY
MINIPE WATER MANAGEMENT PROJECT
COLOMBO
MATARA
MATALE DISTRICT
STAGE 4
800 ha
STAGE 3
1800 ha
DISTRICT BOUNDARY
STAGE 2
1800 ha
KANDY DISTRICT
STAGE 1
1600 ha
PILOT PROJECT
AREA 800 ha

could have a relation to better water management in irrigation projects.

Draft amendments to the present Irrigation Ordinance, proposing the formation of Water Users' Associations in major irrigation projects, have been prepared by the Ministry of Lands and Land Development. These amendments, which are now under consideration by government, attempt to provide the facility for the farmers to organize themselves in a way that, besides helping themselves individually, would also ensure better operation of the irrigation system and better on-farm management of irrigation water.

1.5 Strategy for Farmer-involvement in the Minipe Project

In view of the fact that no effective farmer organizations existed in the Minipe Project, it became necessary to evolve an appropriate strategy to involve the farmers in an effort to improve the very unsatisfactory situation regarding control and issue of water. All previous attempts at achieving proper distribution of water had been based on the usual "top downwards" extension strategy which did not account for the feedback of the farmers' fears and needs. This approach basically tells farmers what to do without allowing them the right to participate in the process of management in any way.

When participative systems are introduced, clients are allowed to understand what it is that they should be doing. But on an individual basis this understanding through participation is much too costly and time-consuming, so that one finds that participation works best on a group basis. Management systems utilizing cohesive groups of participants seem better able to deal with uncertainty and adoption of new technologies. The reason why a technology transfer programme often fails is because it does not recognize the desire of clients to participate, and the power of small group processes in adopting technology. Thus, programmes that are conducted without proper farmer participation fail not only because officials cannot get the feedback and information necessary to design and modify the programme and technology properly but also because the farmer deliberately sabotages the programme by rejecting it. No mechanism has been built in for him to participate, to become a part of the programme, and to contribute meaningful information that could make a success of the programme. Consequently, with no involvement in the building up of the programme, there is usually no subsequent commitment to the programme's success.

Through the writer's experience in working with subsistence farmers in major irrigation projects it has been verified that they are not by nature passive or resistant to interaction and decision making within organizations. They become so as a result of prior experience. The motivation, the potential for development, the capacity for assuming responsibility, and readiness to direct behaviour towards organizational objectives are all present in people. It becomes management's responsibility to recognize that fact and create an environment that will make it possible for people to exercise these latent abilities, needs and desires. The essential task of management is to create organizational conditions and methods of operation so that people can achieve their own goals best by directing their own efforts towards achieving common organizational objectives.

2. THE MINIPE WATER MANAGEMENT PROJECT

2.1 Description of Project

This project comprises an extent of 6050 ha acrea of paddy land irrigated by a main canal 77 km in length and a network of distributary and field canals delivering water up to each individual farm of about 1 ha in average size. The water is led into the main canal by means of a low diversion weir across the Mahaweli river.

The project was constructed in stages. The completion of Stage I of the project was in 1939 at which time around 1600 ha were developed. Stage 2 of the project, covering an area of 1800 ha, was developed in 1957/58. The last two stages of the project comprising about 2650 ha were completed around 1969/70.

Due to the absence of effective distribution systems and the consequent breakdown of discipline, much damage has been caused to the channel system over the years. Whilst a part of the damage has resulted from poor maintenance operations, more damage has been caused wantonly by the farmers themselves. The reasons for this have been briefly stated earlier.

In regard to maintenance work the Irrigation Department, while doing its best under the circumstances, has been generally under-financed, under-staffed and under-equipped to meet all its obligations. Most maintenance works carried out have been actually in the form of emergency repairs to

canals and structures. The rate of rehabilitation of these works has always been much slower than their rate of deterioration.

The Irrigation Department has been responsible for the distribution of water and maintenance of canals to the point of delivery into the field canals. Within the field canals, it is the responsibility of the farmers to distribute the water amongst themselves and to maintain the canal system. In practice this is generally very poorly, even rarely, done.

When the writer took charge of the Minipe Project in 1978 as part of the area under the Kandy District which came under his purview as Deputy Director of Irrigation, the level of water management in this project was extremely low. Whereas the main canal was 77 km long, water rarely flowed into the second half of the canal where about 2650 ha out of the 6050 ha of the project were situated. This happened because of the deteriorated state of the canal systems and also because of ineffective control of water within the first half of the project. Even within this latter area there was serious shortage of water beyond the first reaches of every distributory canal. In addition to the serious under-productivity of the paddy lands in the project, the plight of a large number of innocent farmers, who were unable to sustain themselves, made it imperative that some steps be taken to effect a better distribution of water.

The biggest problem was obviously the lack of any form of participation by farmers in the operation and maintenance of the project and in the distribution of water. Whereas the success of water management at the terminal level depended largely on the efficiency of farmers' associations, there were no effective associations in these projects.

2.2 Preliminary Activities

As the introduction of an effective water management system involved the various government Departments, the writer arranged a meeting, in September 1978, of officers of all connected Departments. This meeting was arranged to discuss the issues involved and to agree on a suitable line of action. The two main areas of agreement at this meeting were:

i. the immediate need for an improved decision-making apparatus for water management at the project level; and

ii. the need to initiate a process to involve the farmers in such management.

2.2.1 Water Management Advisory Committee

The decision-making device that prevailed at that time was merely a statutory meeting held under the Irrigation Ordinance, before each cultivation season. It is called the "kanna meeting" or "cultivation meeting" and is summoned and presided over by the Government Agent of the District or his representative. All farmers in the project are supposed to participate but usually only a few vociferous farmers or those with some grievances attend. Often, the decisions taken by the bureaucracy in advance are foisted on the farmers who therefore rarely cooperate in executing these decisions.

As an interim measure, it was decided to set up at the project level a Water Management Advisory Committee composed of the officers of all key Departments. In the absence of any elected farmer representatives or organizations, the most important element of farmer representation was to be partially effected through the presence of available "village cultivation officers" who are generally sons of farmers in the project. This large group of village level officers of the Agrarian Services Department were temporarily to voice the views of the farmers of their respective areas of operation, within this interim decision-making body. Accordingly the committee was to be comprised of:

i. the Irrigation Engineer in charge of the project (chairman and convenor);

ii. the District Agricultural Extension Officer;

iii. the Assistant Commissioner of Agrarian Services;

iv. all Colonization Officers (Land Commissioners Department); and

v. all Village Cultivation Officers (temporarily to represent the farmers).

This interim committee was to be set up not as a substitute for the statutory "cultivation meeting" but merely as a device to assist that meeting to take rational decisions taking into consideration the views of the farmers. Meetings of this newly set up body were to be held prior to every cultivation meeting to discuss all

relevant issues and decide on all matters related to that particular cultivation season. These decisions were thereafter to be put up at the routine cultivation meeting and adopted by unanimous or majority vote.

2.2.2 Farmer representatives

In regard to the absolute need to involve the farmers in the management of water both at the project level and at the terminal level, it was necessary to have some sort of elected representative to start with. The difficulty here was that there was no statutory provision for the election of any farmer representatives and, further, there were no water users' organizations of any sort either.

It was, therefore, decided to arrange the election of unofficial group representatives at the rate of one for every 20 to 40 ha. The area covered by each representative was to be according to a blocking-out plan drawn up by the Irrigation Department based upon hydrological boundaries. The election, by concensus, was to be informal and held wherever possible at the field canal level through the intervention of the lowest level officers of this area.

Once these group representatives were elected, "area representatives" were to be elected from amongst the earlier elected group representatives. These area representatives were to be representative of areas of between 200 to 400 ha, depending on the hydrological boundaries of the "blocking out plan".

2.2.3 Water distributors

In order to effect proper distribution of water in the numerous distributory and field canals and to do this with the active support and cooperation of the farmers, "water distributors" were to be appointed by the Irrigation Department to correspond with the areas of operation of the farmer representatives. These field level officers were to be selected from the area itself and would thus be sons of the farmers in the project. This was to ensure that they were alive to the problems of the farmers and that they would be able to help increase their confidence in the Irrigation Department.

2.2.4 Selection of pilot area

In order to begin working with farmers at grass roots level and move towards an intensive water management exercise, it was decided to select an area of around 800 ha situated at the head of the main canal as a pilot area for water management. As the whole area of 6050 ha in the project was too large to experiment with, the smaller pilot area provided a suitable working space for all the necessary initial activities.

As for the procedures for operations within this pilot area, no preconceived ideas were to be introduced. It was accepted as policy that whatever procedures that were necessary for better water management, and whatever institutional arrangements were necessary to give effect to this, would grow out of the experiences gained through the interaction of farmers and field level officers within the pilot area.

2.3 Extension Agents

The creation of an effective water management system at all levels within the project necessarily implies the introduction of several related technologies. Besides the improved technology for better water distribution, new techniques of land preparation and cultivation have also to be introduced to farmers. Because developing country institutions do not recognize the importance of the transfer function, extension jobs are often low paid, non-prestigious, overlooked occupations performed by ill-trained, poorly-motivated people who therefore virtually ensure the failure of any effort to promote the use of new technologies. An effective extension agent, on the other hand, serves as the communicative link between the change agency and client. He should not only be technically proficient but should have an above-average understanding of human behaviour as it relates to decision making on unknown risky matters such as the adoption of a new and different technology.

2.3.1 Alternative change agents

Pending the development of the kind of extension agents who can do their jobs well, there remained a void which needed to be filled at least temporarily, if an attempt was to be made to mobilize farmers to the new water management programmes. Because small farmers have been used to living in isolation, and as they are often illiterate, they are usually ignorant of and tend to be suspicious of things that are new to them. Thus the programme needs to contain within itself a strong informational and educational component that reaches down to the

farmer. In view of these considerations the need for alternative change agents was obvious.

2.4 Role of NHP

To meet the need for a cadre of effective change agents to be fielded in the pilot area, the Irrigation Department enlisted the support of a non-governmental organization, the National Heritage Programme (NHP). This organization had as its primary objective the mobilizing of local (human) resources to further agricultural production based on socio-cultural practices of the past. It mobilized the support of religious priests, who had great influence upon the rural masses, and other categories of people such as school teachers, who had close ties with the people in the villages. It also had a team of trained and highly motivated youths who could go to the rural masses and be accepted by them. The youths would usually live with the villagers and act as catalysts in any change programme in which the NHP participated. These youths of the NHP proved to be very effective in playing the role of change agents in the water management effort in the pilot area.

Unfortunately, due primarily to funding problems within the NHP, its involvement in the Minipe Project had to be discontinued at the beginning of 1980. This caused a serious set-back in the water management effort thereafter. However, from the end of 1978 when the NHP started its activities in Minipe up to the time it had to cease operations there, it contributed vastly to the development of farmer awareness, farmer participation in water distribution and in promoting office-farmer interaction within the pilot area.

3. OPERATIONS IN THE PILOT AREA

In October 1978, the NHP organized a massive publicity campaign within the pilot area to explain to the farmers the need for water management and also to motivate them to participate in all related activities. The NHP fielded four youth organizers to correspond to the areas of operations of the four farmer representatives that were to be elected subsequently. They also brought in a large number of other social workers and volunteers to promote the initial activities in this area. A striking feature of the activities of the NHP during this period was a well organized shramadana conducted during the period the main canal was closed between cultivation seasons.[1] This shramadana was to desilt the main canal in the first 16 km of its length, and covering the extent under the pilot area. In addition to the Irrigation Department, the Agrarian Services Department and the Agriculture Department, which participated with the NHP in this programme, all the Rural Development Societies within the pilot area were also brought into the organizing and execution processes.[2] During this operation, about 1000 farmers participated in the work on each day according to a pre-arranged programme. The programme continued daily for a period of two weeks. The main purpose of this campaign was to create an awareness among the farmers of the need to participate actively in the proper maintenance of the system and also to demonstrate to them the results they could achieve by acting unitedly in resolving common problems. This opportunity for close contact between the farmers and all field officers, who also participated in the shramadana activities, was utilized to discuss with farmers the need for proper water management in the project. During the two-week period of the shramadana the NHP organized a series of meetings and seminars where both farmers and officers participated. This enabled the "breaking of the ice" so to say and removed, at least to some extent, long-standing misunderstandings between farmers and officers. Film shows to publicize the usefulness of proper water management and cultural shows using local talent were among the other techniques used to mobilize support of the farmers towards the proposed water management programme.

In February 1979 officers of all Departments working in the pilot area were summoned for a meeting with the farmers. The youth organizers of the NHP, acting as mediators between farmers and officers, took great pains to canvas support for attendance at this meeting. The problem of water management in the area was dicussed at great length and some agreement was reached about measures to introduce whatever degree of control that was possible in the use of irrigation water. As the farmers rightly pointed out, the greatest impediment to such control was the completely deteriorated state of the distributory channel system. They insisted that any

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[1] A self-help programme for a specific common activity.

[2] Government-sponsored societies of rural people formed to promote rural development.

attempt at a more controlled distribution of water should be coupled to an appropriate programme by the Irrigation Department for the rehabilitation of the canals, especially the concrete structures which were so damaged that they were no longer effective. On the other hand, the farmers agreed to organize themselves into shramadana groups which would do part of the earthwork in the canals.

It was also decided to divide the pilot area into 4 sub-areas of about 200 ha each, where more intensive efforts could be made. A two-tier committee system was also agreed upon, one for the whole pilot area and one for each sub-area. These committees were soon set up and started operating.

3.1 Functioning of Committees in Pilot Area

3.1.2 The organizing committee

The committee for the whole pilot area was named "organizing committee" and was composed of:

i. the local Buddhist priest, who was a part of the NHP organization;

ii. the Technical Assistant of the Irrigation Department;

iii. the Agricultural Instructor of the Department of Agriculture;

iv. the Village Cultivation Officers of the Department of Agrarian Services;

v. the Colonisation Officer of the Land Development Department;

vi. four farmer representatives, each elected by the group representatives at the field channel level; and

vii four youth organizers of the NHP, one corresponding to each farmer representative's area.

The farmers suggested that the Buddhist priest, who had an illustrious record of social service in the area for many years, be the Chairman of the Organizing Committee. This was agreed to and he subsequently discharged this role quite successfully. Meetings of the committee were held regularly every month, without any set agenda before them. The farmers and officers discussed openly every possible issue connected with the cultivation and water distribution. The committee invited higher level officers from various Departments whenever they wished to discuss matters of particular interest. Besides this, any persons interested in the programme were always welcome to join in at these discussions. The writer was a frequent visitor and helped to give direction to the activities of this committee. In general, there was a progress review at every meeting and future plans were discussed. There being no preconceived plan of operations, the activities within the Pilot Area and every advance towards better water management was a result of discussions at the meetings of this committee.

3.1.3 Farm Water Management Committees

In respect of each of the sub-areas of the pilot area, covering about 200 ha, a smaller committee was instituted. This committee of four members consisted of:

i. the farmer representative for that sub-area, and also serving in the Organizing Committee;

ii. the water distributor of the Irrigation Department;

iii. the field level extension officer of the Agricultural Department; and

iv. the youth organizer of the NHP.

This committee was essentially a field level committee which held most of its deliberations at that level. They were required to meet at least once a week at a fixed place and at a fixed time, so that farmers who wished to discuss any problems could come to the meeting place without any prior appointments. In between meetings the members of this committee, both individually and collectively, were expected to inspect the distributory canals and field canals to ensure maximum possible efficiency in water distribution. During these inspections they were required to explain the activities of the water management project and enlist the support of each and every farmer towards the new programmes that were being attempted. The youth organizer of the NHP acted as the catalyst in this operation. Besides acting as the convenor and keeping records of all meetings of this committee, he was also expected to encourage and mobilize the farmers to the collective efforts of better on-farm water use.

3.1.4 Farmer-officer meetings

In addition to the above arrangement of committees an additional meeting of

group representatives and officers was held once a month. These meetings were more like seminars where all the group representatives (one for every 20 ha) could participate. There were about 35 such representatives for the Pilot Area. All field level officers of the various Departments actively participated in these meetings and there was very good interaction between them and the farmers. Above all other advantages of these meetings, the two parties were able to understand and appreciate each other's viewpoints more than ever before.

These meetings were organized by the NHP youth organizers who took great pains to ensure full attendance of both officers and farmer representatives. They took notes of the discussions and initiated follow-up action wherever required.

3.2 Shramadana Activities

One of the main strategies adopted by the organizing committee was to involve farmers in shramadana activities to repair the field canals and access roads which had deteriorated badly and for which no government financing was available for rehabilitation. Besides improving the canal system for better water distribution, this activity helped greatly in building up the group spirit amongst farmers and in encouraging them to rise above their petty differences to resolve common problems. The committee also so arranged that field level officers of the various Departments also participated in physical work along with the farmers during these shramadana work camps. This helped to build up the confidence of the farmers in the officers and even promoted personal friendships between them which contributed to further positive interaction later on.

3.3 Socio-cultural Events

Sri Lanka once had very useful cultural practices and ceremonies connected with paddy cultivation. Some of these were particularly related to the efficient use of irrigation water and to better water management where the farmers shared the same source of water.

The NHP quite rightly suggested the revival of some of these customary activities and there was a very good response from the farmers who organized many such events in the Pilot Area. One of the most important and colourful of such ceremonies is the "wap magul" ceremony where a tract of paddy fields are ploughed on the same day, all the farmers within the tract participating on a collective basis. The buffaloes used for the ploughing are pooled together by the participants and all the farmer-families join together in festive spirit, each contributing their own resources to provide the necessary food and drink for the duration of the event.

With regard to the event itself, one can imagine that the ulterior motive of this exercise was to effect better water use by working to an agreed plan and also to discipline farmers to abide by collective decisions in regard to water distribution. It was found that the promotion of this activity in the Pilot Area helped to achieve these objectives to a large degree.

3.4 Rehabilitation of Distribution System

One of the biggest constraints to effecting better water management in the area was the extremely poor state of the distributory and field canals. The only funding available for rehabilitating this system was the meagre annual allocation of funds for "maintenance and improvements". This allocation was based on an island-wide pro rata distribution of the total funds available to the Irrigation Department for this purpose for all the major irrigation projects in the country.

3.5 Effects on Water Use

At the frequent farmer-officer meetings and at meetings of the two committees described earlier, an important issue that was frequently discussed was on-farm water use and avoidance of wastage of water. The officers of the Agriculture Department drove home to the farmers that overuse of water was damaging to crops and that yields were definitely reduced by such practices. Further, they explained to the farmers how the controlled application of water could increase yields. To demonstrate this fact, certain farmers' plots were taken as "demonstration plots" where those farmers themselves subsequently testified to the correctness of this theory.

These and other measures taken within the Pilot Area resulted in a sharp decrease in water wastage. During the first season after the operation of the pilot area, the Irrigation Engineer in charge of the Minipe Project confirmed that there was a 30 percent increase in the flow of water in the

main canal into stage 2 of the project which began at around 30 km along the length of the main canal. The farmers in stage 2 were pleasantly surprised when they noted this change which resolved many of their long-standing water distribution problems, especially along the lower distributory canals.

4. SUBSEQUENT DEVELOPMENTS

4.1 Election of New Farmer Representatives

At the beginning of 1980, when NHP activities at Minipe stopped, another development necessitated a change in strategy. That was the holding of an island-wide election of farmer representatives under the Agrarian Services Act of 1979 by the Department of Agrarian Services. In the Minipe Project too these representatives were elected on the basis of one for about 100 ha of paddy land. As there was bound to be much conflict in relation to the unofficially elected farmer representatives with whom the water management project had proceeded up to this time, it was decided that the project should now work with these legally elected representatives. Fortunately, most of the new representatives elected were the same farmers who had so far actively participated in the water management programme.

In June 1980, after the new representatives had been elected, they were all summoned to a meeting at the project level where the field level as well as district level officers of the three key Departments of Irrigation, Agriculture and Agrarian Services participated. At this meeting, the progress achieved in water management within the project, particularly in the pilot area, was reviewed. It was decided that the intensive efforts and committee system in the pilot area of 800 ha would be discontinued in view of the withdrawl of the NHP and as there was lack of resource personnel to continue operations the previous scale. The new representatives, however, were unanimous that the efforts to better water management in the project should be continued and agreed to participate fully in whatever appropriate programme was decided upon.

4.2 New Committee System

After a full discussion a number of proposals was accepted at this meeting.

The project area of 6050 ha was to be divided up into six sub-project areas of about 1000 ha each, and water management committees set up for each sub-project area. The farmer representatives were to take full responsibility for making decisions regarding distribution of water within the sub-project areas. All the elected farmer representatives within the sub-project area were to be members of the committee, and one of them, elected at its first meeting, was to be chairman of the committee.

All field level officers of the three Departments of Irrigation, Agriculture and Agrarian Services were to be members of the committee and the technical officer of the Irrigation Department were to function as secretary of the committee, which would meet once a month at a fixed place at a fixed time and date. The committee, although primarily meant to deal with water distribution problems, would also deal with general matters regarding the operation and maintenance of the channel system within their areas and also regards other inputs for cultivation such as seed, fertilizer, agricultural credit and farm power.

The water management and related activities of the whole project were to be coordinated and controlled by a "Project Water Management Committee", which would take over the functions of the "Project Water Management Advisory Committee" which had been functioning hitherto. Farmer representatives within each sub-project committee were to elect delegates from among themselves to serve on the Project Committee, at the rate of one per village.[1] The chairmen of the sub-project committees were to be included in this number of delegates. The committee was to include all officers of the three Departments of Irrigation, Agriculture and Agrarian Services who held responsibility at the project level.[2] The Irrigation Engineer in charge of the project was to function as secretary of the committee, which would be chaired by the Special Project Manager, Minipe.[3] In the absence of this officer at any meeting, any other member of the committee (including

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[1] There were 23 villages covering the whole project of 15 000 acres.

[2] There were 20 such officers at the time of formation of the Project Committee.

[3] This was an officer from the Sri Lanka Administrative Service who had been appointed to the project earlier to coordinate all agricultural activities and to help increase production.

farmers) could be elected pro-tem chairman. The committee would meet at the Project Secretariat bi-monthly, and also whenever required.

A "District Advisory Committee" was also to be set up at the district level, to be chaired by the Government Agent of the District and composed also of the District Heads of the three Departments of Irrigation, Agriculture and Agrarian Services, together with the District Land Officer of the Land Commissioner's Department.[1] This committee was to deal effectively and promptly with any policy matters arising at the project level and which required a decision at either the district or national level. This committee would also serve as a back-up organization for all water management activities at Minipe and would resolve any inter-departmental issues that surfaced at the project level.

4.3 Operation of New Committees

The formation of the sub-project area committees took place in July 1980 and the first project committee was held in August 1980. These committees have functioned continuously up to the present time and have proved to be very useful in resolving the problem of water management in the project.

The sub-project level committees have also proved very useful in promoting better understanding between officers and farmers. The monthly meetings of this committee are held in a very informal manner where farmer representatives (about 12 in number) express their opinions freely not only regarding water control, but also about any other subject related to cultivation. The group also discusses the maintenance of the canal system and decides priorities and programmes for canal repairs. Organization of regular shramadana activities were a common feature. This activity helped to bridge the gap between funds available for maintenance work and funds actually required. In addition to participating in group action through this committee, each representative also organizes many other activities with groups of farmers in his area.

Water management is essentially a function of the Irrigation Department and is effected through the lowest level extension officer, the Water Distributor, who is directed and controlled by the Technical Assistant. A Technical Assistant in an irrigation project generally covers an area of around 800-1200 ha and may have two or three maintenance overseers to assist him, these overseers paying more attention to maintenance of the system than to actual water disttribution. In this set-up, the fact that the Technical Assistant functioned as the secretary of the sub-project area water management committee proved very effective. As far as the officers of the Departments of Agriculture and Agrarian Services were concerned, their participation as members of this committee enabled them to have a useful dialogue with the farmers as regards supply of related inputs and the introduction of new techniques in cultivation. On the other hand, this arrangement assisted the farmer representatives to deal simultaneously with the several problems they were faced with in giving effect to decisions regarding water delivery schedules.

The Project Committee deals primarily with making decisions on water distribution problems in the project. As a majority of members of this committee are farmer representatives, a fair degree of democracy in the management of the water resources of the project is ensured. In fact, under this arrangement, all decisions regarding timing of cultivation, rotational water distribution schedules, etc., can be considered as made by the farmers themselves through their representatives. The Irrigation Engineer and all the Technical Assistants of the Irrigation Department who serve as members of the committee merely present the technical facts relating to availability of water and suggest alternatives which may be discussed and decided upon. The other departments, too, being closely connected to the cultivation activities of the farmers, are able to contribute their views, through their officers who are members of this committee, on the alternatives proposed. When the farmer representatives ultimately reach a conclusion, it is necessarily an excellent decision because it has been made after soberly weighing all the pros and cons related to the issue. It is these decisions that are subequently put up to the "kanna meeting" for ratification.[2]

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[1] This Department was in charge of settlement of peasants in colonization schemes (generally under major irrigation projects) and subsequent land administration.

[2] Described previously under para. 2.2.1.

It has been the experience at Minipe that the "kanna meeting" has always ratified these decisions. Perhaps this is due to the confidence farmers have in their own representatives who they know have already discussed these matters carefully with the officers in the project at the Project Water Management Committee.

Besides the distribution of water, the Project Committee also deals with all issues brought up to it from the sub-project area committees. The farmer representatives who are chairmen of these committees, also being members of the Project Committee, are able to seek the advice of this committee to resolve any problems that have defied solution at the sub-project level. More important, they are able to question and receive answers to problems which have to be handled at the project level especially concerning fertilizer, seed, agricultural credit, etc. The responsible officers of the relevant Departments, being members of the Committee, find that this is a useful forum to discuss these issues openly and to clarify any matters that may be raised.

The "District Advisory Committee" never functioned effectively. Since water management at the farm level, and subsequently at the project level, depends greatly on proper coordination of state inputs and on the effectiveness of administrative regulations, it was necessary that the whole system of water management committees be tied up to the district administration The lack of such a connection would, naturally, make the whole system dependent entirely on personal initiatives and on personalities. In fact, in the water management efforts at Minipe, the most serious drawback was the lack of effective official coordination at the District level.

4.4 Introduction to Improved Technology

Improved technologies for increasing water management efficiency had to be introduced step-by-step due to the scarcity of adequate resources. The Project Committee decided to introduce scientific water management in six "experimental blocks", one within each of the sub-project areas. These blocks ranged in extent from 8 to 20 ha. The principal aims of this exercise, which started at the beginning of 1981, were:

i. to measure and issue water to farmers strictly according to a pre-arranged schedule, according to actual crop requirements;

ii. to demonstrate how scientific water distribution should be effected at tertiary level and how yields could be increased by avoiding the over-use of water; and

iii. to promote closer contacts between individual farmers and with the extension officers of the Irrigation and Agriculture Departments.

Each of these blocks was managed by the Sub-Project Committee within which area it was located. The operations were directed by a team consisting of the Technical Assistant (TA) of the Irrigation Department, the two extension officers of the Departments of Agriculture and Agrarian Services, and a farmer representative elected by the farmers within the area concerned. Actual water issues were effected by the water distributor of the Irrigation Department with the active participatin of the farmer representative and of the individual farmers themselves. The schedules of daily water issues were prepared by the TA in consultation with the farmers. These schedules were further amended in the field as and when they were found to be unsatisfatory according to the actual requirements of the farmers. Records of all water issues were kept by the Water Distributor.

The main idea behind the arrangement of experimental blocks was that the work was to be done by the farmers themselves under the guidance and direction of the officers. This principle motivated the farmers sufficiently to make this exercise fairly successful. In all cases it was found that yields had increased considerably due to use of much less irrigation water than these farmers had been traditionally accustomed to. It was thus proved that, given the correct approach, farmers are quite capable of taking responsibility for making scientific water distribution possible.

In addition to the improved technology for water distribution, the extension officer of the Agriculture Department was able to introduce many new techniques for land preparation, sowing, fertilizer application and pest control. In fact these "blocks" served well as demonstration plots for all the farmers within the whole sub-project area. There were frequent visits by groups of farmers to see for themselves the new techniques about which they had so often heard but never really accepted. The results of the successful operation of these blocks had a tremendous effect on the

farmers both within these blocks and also in the neighbouring areas. The impact of this controlled water use on the overall water management plan was appreciable. However, the continuation of these blocks, and their extension to cover the whole project area, depended on the establishment of suitable farmer organizations at the tertiary level. There being no subsequent activity in regard to this requirement, the continuation of these experimental blocks became more and more difficult. They were in fact discontinued towards the end of 1982.

4.5 The Transfer Function

Technology transfer involves a process whereby technical information in an institutional setting is adopted for use by people in an entirely a different setting. While technology transfer is a transmission process running from source to user, the emphasis should be on studying how the source and the intermediates effectively transmit technology to the user. This means that effective transmission primarily concerns what kind of credit arrangements, technical aid and various input factors the source can bring to the user to make it possible for the user to make the risky decision of adopting a new technology package. In the group process adopted through the new committee system for water management at Minipe the extension agent served as a quasi-leader in the initiation phases. For a time, the agent had necessarily to serve as a leader, generally carrying out the leadership functions of initiation, administration and interpretation. As the group matured, the farmers were able to take over many of the agent's functions. However, even when such leadership had evolved, the agent still needed to interact with the group and in varying degrees continued to carry out the leadership function. In a way, leadership may always involve the participation of the outsider, the extension agent, since he has to handle much of the formal administrative work for the group especially in relation to interaction with higher levels of his own organization and with other agencies.

The organizational structure plays an important role in the transfer of technology to subsistence farmers. As mentioned earlier, the usual pyrmidal "top-downward" system was not adopted at Minipe. Through the operation of the committee system this pyramid was distorted into a series of overlapping pyramids linked to each other through the extension agents and farmer representatives who could interchange information from groups within the overlapping pyramids. All administrators, no matter at what level they operated, interacted with the lowest client level although to a lesser degree than extension agents. Also, a number of small groups (sub-project area committees) with elected leaders, shared the leadership of the groups with extension workers, forming the base of the organization. The farmer representative and extension agent in turn are included in a second order control group (the Project Committee) interacting with the second level field administrators. These second order people are in turn in contact with the even higher level representing the top administrators (the District Advisory Committe) who make the major administrative decisions based upon the feedback information obtained through the lower level control groups.

5. CONSTRAINTS TO PROGRESS

The water management committees at Minipe have been functioning satisfactorily, although with some drawbacks. A noticeable weak point is the poor attendance of officers of some Departments at the committee meetings. This is purely a result of the non-effective coordination of the key Departments at the district and national levels. Another shortcoming is the lack of financial resources necessary to proceed with the task of increasing the pace of the water management programme. For instance, the participation of individual farmers is presently enlisted primarily through their representatives elected under statutory provision. For an increase in water management efficiency it is essential to carry the participative management process down to the level of the individual farmer. This requires enlargement of the scope of activities with proper tie-up to and direction from the national level. Resource personnel will be required in fairly large numbers to act as change agents in the social transformation which is really necessary to effect an increase in water-use efficiency to any considerable degree.

In spite of these and other constraints, the discontinuation of the present committees, which at least offer some degree of effective farmer participation, is very unlikely. The farmers have now become accustomed to the new decision-making processes through their representatives and will resist any attempts to go back to the confused situation that prevailed earlier. Further, there are a good number of field offiers who find that

their extension work has become much easier due to the regular ready-made forum of the water management committees of which they themselves are members. The coordination of activities within each sub-project area being done by the farmer-chairman of the sub-project committee, instead of by a government official, gives him sufficient motive to work towards the safeguarding, continuation and improvement of the system.

6. INDEPENDENT USERS' ORGANIZATION

So far, no attempt has been made to introduce independent users' organization, either at the turnout or higher levels. It was felt that very little purpose would be served by this whilst the macro-level system management was ineffective, as is the case in many major projects. It would be futile to organize farmers in a turnout group unless they themselves were in some tangible way connected to the overall decision-making process both in relation to their own area as well as to the entire project itself. It is only if a suitable framework exists and when a favourable climate is created that farmers could really benefit by forming associations to participate in water management.

As far as Minipe is concerned, these conditions are now prevailing and it would not be difficult to organize farmers into independent groups or water users' organizations which could participate or even take over the control of activities for water management.

7. COMPARISON WITH GAL OYA PROJECT

7.1 Use of Catalysts

A common feature at Gal Oya and at Minipe is the use of a catalyst in bringing about the transformations in farmer-farmer, farmer-officer, and officer-officer relationships. In regard to the type and quality of the catalysts used in the two projects, there are basic differences. At Gal Oya the accent was on the use of university graduates with subsequent specialized training by ARTI (in collaboration with Cornell University) whereas at Minipe only youths with a secondary school education were involved. Although these youths also had undergone some training and experience in interacting with farmers in a change programme such as they were engaged upon, their prime motivation was through a strong socio-religious action programme of the organization (NHP) they belonged to. The NHP believed that leadership in the rural areas should be built upon the indigenous institutions existing in the village. The Buddhist priests in the villages wielded considerable influence with the people and played a traditional leadership role, especially in relation to water management for paddy cultivation. The NHP believed that these priests were a resource that should be fully utilized in any change programme for development in the villages. Accordingly, in the activities of the Pilot Area, even these priests were appropriately oriented towards the water management project and used as catalysts in the social transformation that was being attempted.

7.2 The Cost Factor

The project at Gal Oya is basically a high-cost venture where the physical rehabilitation of the irrigation network is relatively expensive. In fact, it is precisely because of this that this rehabilitation work has been coupled to a parallel programme for improved water management and the building up of farmer organizations.

In the Minipe project, on the contrary, the rehabilitation of the canal system was limited more or less to the normal governmental allocation for "improvements", which was given on a proportionate basis considering the extent of paddy lands under the project in relation to the total paddy area under the major irrigation projects in the country. The water management project at Minipe was primarily an exercise in mobilizing local resources to effect better water distribution.

7.3 Levels of Participation

Whilst at Gal Oya the building up of farmer participation has so far been attempted principally at the grass roots level, the Minipe Project, although initially operated in similar fashion, enlarged operations to cover all levels of management within a period of two years of commencement. As described earlier, this was a move made out of necessity mainly due to difficulties of continuing the grass root level activity in the pilot area. However, it was an excellent alternative to abandoning the water management effort altogether. Further, this move did not close the doors to re-introducing such grass root level activity in the pilot area or elsewhere in the project. On the other hand, it provided a very satisfactory framework within which any future

efforts in this direction would easily succeed.

In respect to Gal Oya, it is interesting to note that it has now been found necessary to set up a mechanism for resolution of conflicts between the different user groups in the project as otherwise the efforts at lower and farm levels for better operation and maintenance will not yield the expected results. As a step in this direction, a process of federation of field channel groups is now being started and D-channel level organizations have already been informally formed. It appears appropriate now to effect a system of committees to ensure the active participation of farmers (through their representatives) at all levels of the system, including the highest (project) level. It is only when farmers feel part and parcel of the entire decision-making process that they can wholeheartedly partake of efforts to reduce water use at lower levels of the system.

Although the decision making at macro level in the Minope project is almost entirely in the hands of the farmer representatives at the Project Water Management Committee, this arrangement would obviously not easily be replicable at Gal Oya. The situation there differs not only because there are user groups with distinctly different demands (large areas are devoted to sugarcane) but also because of overlapping administrative boundaries. In addition to being sub-divided into a number of separate cultivation meeting areas, the project also falls within several administrative districts with coflicting interests.[1] However, it will not be difficult to set up an adequate mechanism to allow for proper farmer representation at project level decision making provided there is some reasonable organization of farmers at the lower levels. In this context, the efforts at building up farmer organizations at the various sub-project levels, as is now being done at Gal Oya, could be seen as a step in the right direction.

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[1] Described in para. 2.2.1.

MINOR IRRIGATION DEVELOPMENT AND MANAGEMENT IN BANGLADESH

by

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1. GENERAL

2. THE MINOR IRRIGATION SYSTEM

3. IRRIGATION MANAGEMENT

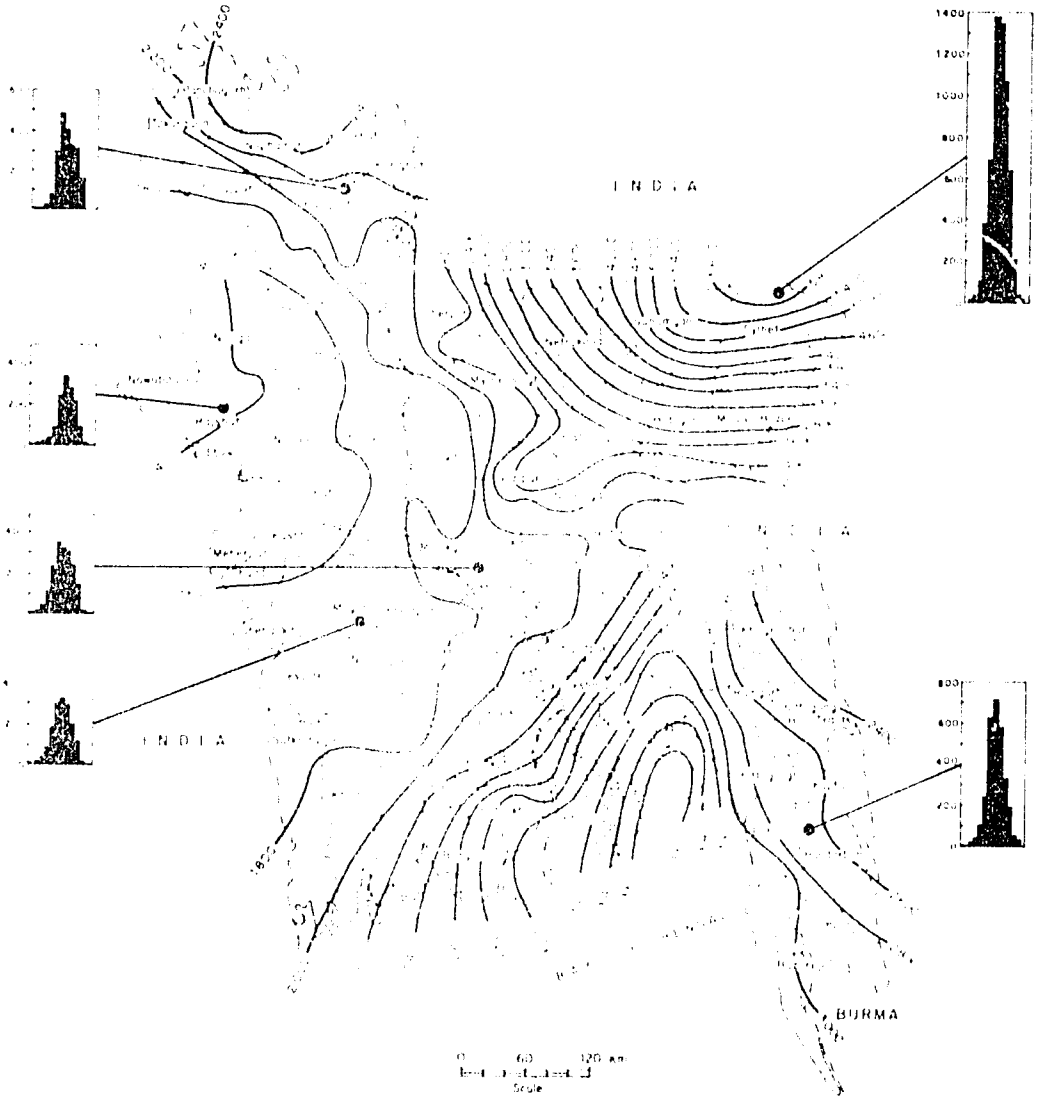

Fig. 1 Mean annual rainfall and mean monthly distribution at selected stations

1. GENERAL

Bangladesh, with a gross area of 144 000 km² and a population of about 92 million, is one of the most densely populated countries in the world. It is located between 21° and 26° N latitude and 88° and 90° E longitude. The country is situated in the lower part of a very large river basin formed by the Ganges (Padma), Brahmaputra (Jamuna) and Meghna rivers. These river systems drain one of the heaviest rainfalls in the world.

The country has a tropical monsoon climate and experiences two seasons every year - the wet season and the dry season. The wet season lasts from June to October and the dry season from November to May. The average annual rainfall ranges from about 1250 mm to 4000 mm (Fig. 1). The country has good fertile land but is subject to both floods and droughts as the country has too much water during the wet season (when about half of the country is flooded) and too little water in the dry season, making it difficult to grow crops effectively without irrigation.

Agriculture plays a dominant role in the economy, accounting for 55 percent of gross domestic product, 75 percent of total employment and more than 90 percent of exports. Of the gross area of 14.4 million ha, 9.1 million ha are cultivated with a cropping intensity of 147 percent. Rice is the major crop and is grown on 80 percent of the cropped area.

With the increase of population, more food is needed but land is limited and gradually decreasing due to urbanization. The only way Bangladesh can meet its present and future food requirements is by increasing the cropping intensity and yield through supply of irrigation inputs.

About 22 percent of cultivable land is covered by irrigation. The irrigation programme under the 2nd Five Year Plan of the Government of Bangladesh (see Annex I) has envisaged a target of 2.90 million ha of land under irrigation by 1984-85. The area covered under various irrigation systems on 30 June 1983 is given in Table 1.

2. THE MINOR IRRIGATION SYSTEM

Under this system, surface water is used by low-lift pumps while groundwater is harnessed through installation of tubewells. Since the projects belonging to minor irrigation systems have very little or no gestation periods and can bring immediate benefits, their expansion has become rapid and now amounts to 90 percent of the total organized irrigation command in the country. The Bangladesh Agricultural Development Corporation is the main agency responsible for the minor irrigation programme through small-scale irrigation projects using low-lift pumps, and deep and shallow tubewells.

Low lift pumps (LLP) are normally of 28-57 litre/second capacity driven by surface mounted 6.5-12 kW diesel engines or electric motors. From a modest beginning in 1960, the numbers

Table 1 PRESENT IRRIGATION COVERAGE

Irrigation system	Organization	Coverage (1000 ha)
A. Large-scale Irrigation (Gravity)	Bangladesh Water Development Board (BWDB)	170
B. Minor Irrigation:		
a. Low lift pump (LLP)	Bangladesh Agricultural Development Corporation (BADC)	655
b. Deep tubewell (DTW)	BADC	286
c. Shallow tubewell (STW)	Bangladesh Agricultural Development Corporation (BADC), Bangladesh Krishi Bank (BKB), Bangladesh Bank (BB)	504
d. Hand tubewell (HTW)	Bangladesh Rural Development Board (BRDB) and Bangladesh Agricultural Development Corporation	36
C. Traditional	Farmers	364
TOTAL		2015

of LLPs operated during the year 1982-83 have reached 41 765 and accounted for 32.5 percent of irrigation in the country.

Deep tubewells (DTW): Development of groundwater by deep tubewells was first introduced in the early 1960s. The DTWs are normally located in areas where surface water is not readily available or its use is uneconomical. A typical DTW is of 15 cm diameter and drilled to a depth of 60-80 m. A deep well turbine pump of 57 litre/second capacity driven by either surface mounted 15-20 kW diesel engine or electric motor is set for pumping water from the well. It has a command area of 32-40 ha. As at June 1983 a total of 17 675 DTWs have been installed and about 14.2 percent of the total irrigated area is covered by deep tubewell irrigation.

Shallow tubewell (STW) irrigation began in 1973-74. A typical STW is of 10 cm diameter drilled to a depth of 30-40 m and has a 12 m strainer, directly coupled with a centrifugal pump (of 14-20 litre/second capacity) driven by surface mounted 4-5 kW diesel engine or electric motor. It has a command area of 6-10 ha.

Since the STWs are operated by centrifugal pumps, their location is limited to the area where pumping water level remains within the suction limit of the pump. STWs, however, involve less installation cost, relatively easy sinking, operation and maintenance technology and are suited to small groups of farmers. Their development was therefore rapid.

Besides the BADC, other public sector agencies such as the Bangladesh Krishi Bank and Bangladesh Bank have programmes for STWs. In 1982-83, STWs accounted for 25.02 percent of total irrigation.

3. IRRIGATION MANAGEMENT

Farmers are responsible the management of all types of minor irrigation systems while the public sector agencies provide support services and supplies. Initially, the irrigation facilities were being used far below their potential capacity. The main reason for this is the absence of effective farmers' participation. Since minor irrigation covers about 90 percent of the country's total irrigated command area, farmers involvement is essential if optimum benefit is to be achieved from irrigated agriculture. The Government of Bangladesh with IDA assistance therefore undertook an Irrigation Management Pilot Programme (IMPP) in 1979. The main objectives of the programme are:

- to maximize coverage under irrigation;
- to maximize yield and production;
- to maximize participation of farmers; and
- to minimize irrigation cost.

In order to achieve these objectives the following activities were envisaged:

- to teach irrigation practices to the farmers;
- to ensure timely supply of inputs;
- to develop an appropriate institutional framework for effective utilization and maintenance of irrigation units.

Through IMPP three public agencies cooperated to help the farmers. The BRDB was responsible for organizing the user groups and channeling credit and other complementary inputs to such groups. The BADC guaranteed supply of spare parts and servicing and also guaranteed supply of oil/fuel, fertilizer and seeds to the farmers' cooperatives. Finally, the Directorate of Extension and Management (DEM) provided extension services on agricultural practices.

The results obtained were extremely encouraging. Farmer participation increased the number of beneficiaries by 62 percent from the pre-IMPP level. Other achievements are included in Annex II.

In view of the spectacular success of IMPP, the lessons learned from it and the excellent cooperative team spirit of BADC, BRDB and DEM Field Officers at various levels, it was decided that this programme would be extended nationwide to speed irrigation development through effective farmers' participation.

Progress made in implementing the IMP Scheme is shown below:

Year	Nos. of farmers' cooperatives	Nos. of irrigation units in IMP scheme
1983-84	75	375
1984-85	150	750
1985-86	225	1575
1986-87	300	3300
TOTAL	750	6000

The Government also decided to transfer ownership of the irrigation equipment to the farmers. This programme started in 1980-81 with three major objectives:

- more participation by the farmers/users;
- transfer of capital cost to the user; and
- better utilization of the irrigation equipment.

In the first year the response was not very encouraging but it picked up gradually and now about 87 percent of the total irrigation equipment in use is owned by the farmers themselves. The details are shown in Table 2.

Table 2 IRRIGATION EQUIPMENT UNDER PRIVATE OWNERSHIP

Types	Total (Number)	Public ownership (Number)	Private ownership	
			Number	% of total
Low lift pump	42 845	9 108	33 737	79
Deep tubewell	17 675	12 617	5 058	28.6
Shallow tubewell	107 629	-	107 629	100

ANNEX I

SUMMARY OF IRRIGATION PROGRAMME DURING SECOND FIVE YEAR PLAN (1980-85)
(areas in 1000 ha)

Agency/ Programme	Achievement as on June 1983			Second five year (1980-85) plan target		
	No. in operation	Area irrigated	Percentage %	Number	Area	Percent
A. BWDB (Irrig.)	-	170	8.42	-	405	13.96
B. BADC (Irrig.)						
LLP	41 765	655	32.49	50 000	830	28.72
STW	62 253	298	14.80	90 000	450	15.51
DTW	13 794	286	14.20	25 000	600	20.68
HTW	185 620	21	1.04	300 000	35	1.20
Subtotal		1 430	70.95		2 320	80.07
C. Private (Irrig.)						
BKB (STW) & BB	43 024	206	10.25	30 000	151	5.20
BRDB (HTW)	133 000	15	0.75	200 000	24	0.82
Traditional	-	364	18.05	-	405	13.91
Subtotal		585	29.05		580	19.93
Grand Total		2 015	100		2 900	100

ANNEX II

COMPARATIVE PERFORMANCE UNDER IRRIGATION MANAGEMENT PILOT PROGRAMME (IMPP)
1979-80

Key indicators	Unit	Comparative performance		
		1978-79 (Before IMPP)	1979-80 (After IMPP)	Percentage (+) increase (-) decrease
Command area of DTWs:				
(a) Total area covered	hectare	417	760	(+) 82%
(b) Net average area covered per DTW	hectare	21	38	(+) 81%
Participation:				
(a) Total beneficiaries	nos.	1 664	2 690	(+) 62%
KSS members	nos.	898	1 361	(+) 52%
Non-members	nos.	766	1 329	(+) 73%
(b) KSS members per DTW	nos.	45	68	(+) 51%
(c) Non-members per DTW	nos.	38	66	(+) 74%
Employment generation	nos.	80	120	(+) 50%

Krishnak Shamabay Samity (Farmers Cooperative Society)

WATER MANAGEMENT OF RICE FIELDS IN THE REPUBLIC OF KOREA

by

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1. INTRODUCTION

2. ORGANIZATION

3. OPERATION AND MAINTENANCE

4. RECOMMENDATIONS

1. INTRODUCTION

The total arable land in the Republic of Korea is about 2 108 000 ha, or roughly 21 percent of its territory (9 902 000 ha). It consists of about 1 312 000 ha of rice paddy fields and about 869 000 ha of uplands. One-third of the rice paddy has single rice and the remaining two-thirds has one more crop, mainly barley, during the non-rice growing period. The upland area includes 101 000 ha of orchards and 16 000 ha of mulberry plantations. In 1982, the rice paddy comprised 917 000 ha with full irrigation and 395 000 ha with partial irrigation. About 444 000 ha of rice paddy are managed by the Farmland Improvement Associations (FLIAs).

Average annual rainfall in the Republic of Korea is about 1200 mm and the major part of it comes in summer, June to September. Most crops, particularly rice, can be grown only in the hot and rainy summer. Because the Republic of Korea has a dry and cold winter, crops cannot be cultivated under natural conditions in winter.

Development of irrigation water and management of irrigation projects in the Republic of Korea are planned by the Ministry of Agriculture and Fisheries (MAF) and their feasibility study, detailed design and construction are carried out by the Agricultural Development Corporation (ADC), based on the Rural Modernization Promotion Law. The provincial governor is responsible for the development of small irrigation projects. On the completion of an irrigation project by ADC or a provincial authority, the project is usually transferred to the related FLIA for operation and maintenance of its irrigation and drainage systems. In the Republic of Korea, 103 FLIAs have been established throughout the country. The provincial governor has overall responsibilities for the management of FLIAs located within the boundary of the province. The chief of a FLIA which controls more than 5000 ha is nominated by the Minister of MAF; other FLIA chiefs are nominated by the governor of the province.

The problems which arise in irrigation water management are as follows:

- most irrigation facilities are so old that they are not functioning properly;
- labour-oriented facilities installed in the past are no longer appropriate to the present advanced technical and social conditions because the number of labourers in rural areas has been considerably reduced during the past decade.

However, it is considered that the high yield of rice produced in the Republic of Korea with old and unsuitable facilities has resulted from the farmers' mutual cooperation and their on-the-job training.

Large-scale irrigation projects began in 1970 and six projects of about 71 000 ha have been completed and 9 projects of about 138 000 ha are under construction.

2. ORGANIZATION

A small irrigation project is initiated by the residents' request. But a large-scale project planned by the Government can be started with the agreement of two-thirds of the farmers.

During construction, the farmers' opinions on the planning and execution

Table 1 AVERAGE MONTHLY RAINFALL, TEMPERATURE AND EVAPORATION IN SUWON

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Average Rainfall (mm)	24.8	32.3	44.9	119.1	81.1	123.4	343.2	297.5	136.5	55.3	47.7	20.6	1326.4
Average Temperature (°C)	-3.6	-2.1	3.4	10.9	16.4	20.7	24.5	25.0	19.8	12.8	5.6	-1.5	
Average Evaporation (mm)	34.6	43.1	72.1	114.2	142.7	160.0	96.8	135.4	95.2	55.3	50.7	38.9	1039

of the project are fed to the executing agency through Heungnonggae, which is a farmers' mutual self-help system. Their cooperation is enlisted through the same agency.

Operation and maintenance of the irrigation and drainage systems are mainly the responsibility of the FLIA. However, irrigation committees meet annually in early spring before the new cultivating season and from time to time during the season. The main topics covered by these committees will be the time of seeding, application of varieties, cropping patterns, cooperative control of pests and insects, irrigation scheduling and the production plan. Irrigation and drainage facilities below the secondary canals should be operated and maintained by the farmers.

During the construction of a large-scale irrigation project, operation and maintenance of the completed sub-areas in the project area are done by ADC, the executing agency.

O&M rehabilitation works which raise technical problems which cannot be solved by the FLIA itself would be carried out by ADC, or the union of FLIA. The Bureau of Farmland, MAF, of the Farmland Division of a Provincial government has the right of administrative supervision of the FLIAs.

3. OPERATION AND MAINTENANCE

The supply of irrigation water up to secondary canals is scheduled by the FLIA after consideration of the farmers' transplanting plan. Water supply below secondary canals is the farmers' own responsibility. Operation and maintenance of irrigation and drainage facilities are mainly carried out by the FLIA.

Water charges paid by the farmers to the FLIA meet the major portion of the FLIA's financial costs. These include management, loan repayment, O&M and the maintenance of a reserve fund.

The reasons why rice yield is high in the Republic of Korea include improvement of water management, guidance of farming practices, active investment in farming and farmers' cooperative participation. The latter is considered to be the most important.

4. RECOMMENDATIONS

The agricultural population in the Republic of Korea has decreased in step with the rapid development of non-agricultural fields. Therefore the irrigation facilities should now be rehabilitated to keep them in line with new water management techniques and the introduction of modern farm machinery.

Several experimental or demonstration farms for the study of modernization of irrigation systems and effective water management should be planned.

IRRIGATION DEVELOPMENT AND FARMERS' PARTICIPATION IN MALAYSIA

by

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1. GENERAL CONDITIONS
2. AGRICULTURE
3. IRRIGATED AGRICULTURE
4. IRRIGATION DEVELOPMENT
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1. GENERAL CONDITIONS

Malaysia covers an area of 330 000 km² and consists of the eleven states of Peninsular Malaysia and the States of Sabah and Sarawak. Peninsular Malaysia occupies 40 percent of the land area and has about 85 percent of the total population of 13.4 million (1980 census).

Situated near the equator between latitudes 1° and 7° North and longitudes 100° and 119° East, Malaysia has a wet equatorial climate. The principal features of the climate are continuous warm temperature and seasonal distribution of rainfall. In the lowlands mean daily temperature ranges from 21° to 32°C; cooler temperatures are experienced at higher altitudes. Rainfall distribution is highly variable both in time and in space. In most parts of the country, soil moisture deficit is experienced for one or more periods in a year. Conversely, excessive rainfall occurs from time to time and results in widespread flooding in the plains. Malaysia has an average rainfall of 2 500 mm/year.

2. AGRICULTURE

Agriculture plays an important role in the country's economy. The agricultural sector which includes forestry and fisheries provides employment for about 40 percent of the working population, and accounts for 22 percent of the gross domestic product. It is heavily oriented to the export market particularly in respect of such commodities as natural rubber, palm oil, hard woods and cocoa, for which Malaysia ranks among the most important producers in the world.

Of the 4.3 million hectares of cultivated land, a large proportion is under the two most important crops of rubber (45 percent) and oil palm (22 percent). Rice, accounting for some 14 percent of agricultural land use, is largely confined to areas situated on coastal plains.

3. IRRIGATED AGRICULTURE

Until recently, large-scale irrigation was confined to wet paddy. Among the annual food crops, paddy occupies by far the largest hectarage of cultivated land, and like many countries in Asia, rice is the staple food crop in Malaysia.

Initially (since the 1920s) with a view to reducing the country's over-dependence on rice imports and later (since the early 1960s) with the additional objective of alleviating the poverty of the paddy-farming community, Government has embarked on a continuous irrigation development programme. Under the recent Government's National Agriculture Policy, a self-sufficiency level in rice of 80-85 percent has been set. To achieve this, irrigation development will have to be sustained.

4. IRRIGATION DEVELOPMENT

Increase in rice production in Malaysia has been achieved through increase in area under cultivation, increase in yield per unit area and increase in cropping intensity.

Early irrigation development dates back to about 1880 when engineering survey work was initiated for the Krian Irrigation Scheme, the first irrigated area in the country. Since then, and especially following the establishment of a specialized government agency - the Drainage and Irrigation Department - in 1932 to deal with problems of land and water development with particular referene to the utilization of these natural resources for increasing rice production through irrigation, rice-growing areas equipped with irrigation facilities increased steadily. By 1959, some 213 600 ha of paddy were under irrigation. However, until then irrigation schemes were designed to enable the planting of one crop of paddy in a year during the wet season, the main feature of these schemes being to supplement rainfall with an irrigation supply throughout the growing season.

The early 1960s saw the beginning of an accelerated irrigation development programme as an integral part of a massive rural development programme to improve the socio-economic conditions of rural areas, and to improve the income of paddy farmers. The thrust of the programme was to develop adequate water supplies and to expand and upgrade irrigation facilities in existing areas to enable the cultivation of a second crop of paddy - the dry season crop - during the year. By 1980, of some 310 000 ha of irrigated land, about 229 000 ha were equipped with facilities for double-cropping. Practically all major rice-producing areas were equipped to grow two crops of paddy in a year. Such areas include Muda (95 000 ha), Krian (22 [illegible]90 ha), Tg. Karang (19 000 ha) and Kemubu (19 200 ha).

Capital investment in irrigation development from 1900 to 1960 amounted to about M$ 63 million. Accelerated development since 1960 resulted in a

further investment of M$ 249 million from 1961 to 1970 and M$ 465 million from 1971 to 1980. Given these investments, coupled with the use of high-yielding varieties, improved farming practices through agricultural extension and subsidies in recent years, rice production in this country has increased significantly over the years:

Year	Rice Production
1930	250 000 tonnes
1960	578 000 tonnes
1970	1 080 000 tonnes
1980	1 340 000 tonnes

Apart from the expansion of area under cultivation and the increase in cropping intensity in existing major rice-producing areas, the increase in yield per unit area has also helped increase production. In 1980 the average paddy yield for the wet season was 3.2 tonnes/ha and that for the dry season was 3.46 tonnes/ha as compared with 2.5 tonnes/ha and 2.6 tonnes/ha respectively in 1960.

5. MORE RECENT DEVELOPMENTS

In spite of this significant increase in rice production, Malaysia's agricultural potential has yet to be fully exploited. The average yield in many recently completed projects is still below what the high-yielding varieties are capable of producing. A major cause of this is inadequate on-farm facilities for effective water distribution and control which are essential for high yield. In most of the major irrigation projects, the canal density is between 10 and 20 m/ha, and irrigation is mainly effected by passing water from field to field. As a consequence, late delivery of water to individual farms further from the canals is not uncommon, cropping schedules cannot be followed and the desired cropping intensity is seldom achieved. The other effects are prolonged irrigation, low efficiency in water use and wastage of the water resource.

The necessity for improved control over water distribution in the field as well as other on-farm facilities has also become pressing in recent years because of a growing labour shortage in the agricultural sector. Due to a state of accelerated development in all sectors of the country's economy, competing demands have been placed on available labour. The effect of this shortage is particularly acute where the traditional form of paddy cultivation is practised, as it is highly labour intensive.

According to a survey of the Muda area, the average labour input required in 1974 to cultivate one hectare of paddy land was 615 man-hours, of which a major portion made up of 40 and 25 percent respectively utilized on harvesting and transplanting. Mechanization of land preparation and harvesting activities has made it possible for this labour requirement to be reduced to 255 man-hours per hectare in 1981. Even so, about 50 percent of the labour is expended on transplanting which, for the most part, is undertaken manually. A further significant reduction in the labour requirement for paddy cultivation can still be achieved if transplanting is mechanized or, alternatively, eliminated through direct seeding.

For farm mechanization to be successfully realized, sufficient drainage control and adequate farm roads are essential. The former improves the foundation characteristics of the soil enabling machine movements in the field whilst the latter provides for machine mobility. For direct seeding to be considered, total control over water level in the fields is a prerequisite.

In the light of this, much attention has been focussed in recent years on the provision of tertiary facilities in the major irrigated areas of the country as this would not only create the necessary environment for high productivity and efficient use of water but also enable the labour requirements for paddy cultivation to be substantially reduced.

Since the late 1970s, a programme of development covering practically all the major rice-producing areas has been undertaken. Under this programme, canal densities would be upgraded to at least 30 m/ha, and tertiary drains complementary to the tertiary canal systems and farm roads to facilitate transport of farm machinery, farm inputs and farm produce, would be provided. Agricultural extension and support services, input subsidies, agricultural credits, rice milling and marketing services would be strengthened. Suitable institutional arrangements are made to ensure that the engineering infrastructures and all agricultural support services are provided in an integrated fashion in each of the project areas.

6. FARMERS' PARTICIPATION

Although in the past farmers had constructed rudimentary irrigation facilities such as brushwood weirs and

water wheels in small paddy areas, this communal effort ceased once Government intervened by providing proper irrigation and drainage facilities. Indeed the role of the Drainage and Irrigation Department has been embracing in this regard in that it undertakes not only the construction of all irrigation and drainage facilities but also the maintenance and operation of the completed works.

The provision of tertiary canal systems would make it possible to deliver water to individual farms in accordance with irrigation schedules. However, the necessary water control at the farm level in conformity with crop water requirements and cultural practice must of necessity be exercised by individual farmers.

Realizing the role of the farmer in managing irrigation water as an input for improved crop yield, the Drainage and Irrigation Department has recently begun to involve farmers in tertiary irrigation development work with a view to their eventual participation in the maintenance and operation of tertiary canal and drainage systems.

A major experience in this regard concerns farmers' participation in the process of planning tertiary irrigation and drainage systems in the Muda Irrigation Project. The procedures used are as follows. First, a meeting is held with local leaders and persons well respected by farmers within a proposed tertiary irrigation development block (usually 600 ha to 800 ha in size). At this meeting subjects pertaining to benefits expected of the development, amenities brought about by the project, and farmers' participation and cooperation will be discussed in general terms. Having been informed of the proposed development, the local leaders are requested to inform the farmers concerned. This is followed by subsequent sessions with separate groups of farmers, during which both engineering proposals and agricultural aspects are discussed. Comments are invited from the farmers as to the alignment of canals, drains and farm roads, the types of canals and farm roads, location of canal structures, irrigation scheduling, etc. Views expressed by the farmers are recorded, categorized and studied. A verification survey is undertaken to confirm the validity of farmers' comments on canal and drain alignments and structure locations. The tertiary system layouts are then finalized having regard to the views and comments by the farmers and additional information subsequently obtained.

This process serves not only to inform farmers of the proposed development directly affecting them, but also to involve them in the finalization of the tertiary system layout, which leads to their ready acceptance of the system. A significant contribution by the farmers is their comments on the proposed canal and drain alignments based on their intimate knowledge of the conditions on the ground. Verification surveys have often proved the validity of farmers' proposals for alternative alignments.

The next step towards farmers' participation is the formation of farmer groups who will eventually be responsible for the operation and maintenance of tertiary systems. It is envisaged that the water management function of farmer groups would be integrated with their production activities such as obtaining agricultural extension services, credits and input supply. The form and mode of operations of these farmer groups have yet to be evolved.

PROGRAMMES AND EXPERIENCES IN INVOLVING FARMERS TO IMPROVE IRRIGATION SYSTEM PERFORMANCE IN NEPAL

by

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1. IRRIGATION MANAGEMENT CONDITIONS

1.1 General

Nepal, sandwiched beteen India and China, has a picturesque landscape spread over 141 000 km². The economy is basically agricultural and agriculture supports the development of other sectors of the economy. However, much of the area is mountainous and only 22 percent of the area (3.1 million ha) is cultivable. Irrigation is practised on a meagre 500 000 ha (approximately 17 percent of the cultivated land) whereas the irrigation potential is estimated at 1.9 million ha during the dry season.

Agriculture in Nepal is largely rainfed and consequently both crop productivity and cropping intensity are low. Average yields of major crops are 1.88 t/ha for paddy, 1.14 t/ha for wheat and 1.69 mt/ha for maize. Moreover, crop productivity has been declining largely recently because of environmental.

Agricultural production, however, is still increasing mainly as a result of the extension of cultivated land and bringing more marginal land into cultivation. But there is little potential for further expansion. Nepal has a population of 16 million people, which is growing at 2.66 percent/year. The extra food they need will have to come from increased productivity brought about by irrigation, agricultural inputs and appropriate supporting institutions.

Nepal's Sixth Plan (1980-85) envisaged the provision of irrigation facilities for an additional 233 000 ha, which is close to the total irrigation command developed by the Government up to the end of the Fifth Plan. Of the irrigation proposed, 86 percent is planned for the Terai plain. Small projects (of less than 100 ha) account for only 13 percent of the total. Being a water rich country, irrigation from surface water dominates the plans and groundwater irrigation accounts for only 10 percent of the area. Progress in the first three years of the plan period is, however, 20 percent below the plan target.

1.2 Irrigation Systems

Four-fifths of the existing irrigation of 500 000 ha has been developed by farmers. Government schemes constitute only 100 000 ha. Most of the available irrigation is supplementary, providing additional water for the monsoon crop. Only 115 000 ha of land (23 percent of the existing irrigation) is estimated to have year-round irrigation, with a higher proportion in the Hills (33 percent) than in the Terai (19 percent). Similarly, 43 percent of Government irrigation has year-round irrigation capability while only 19 percent of farmers' irrigation schemes service a second crop. Only ten percent of farmers' irrigation schemes in the Terai provide water for a second/dry season crop. Excessive loss of water in the system, inability to raise river water level during minimum flow and technical difficulties in tapping large perennial rivers in the Terai are some of the causes of seasonality in farmers' irrigation.

Both Government and farmers' irrigation are dominated by gravity systems with run-of-the-river diversion. Pump and groundwater schemes constitute only 13 percent and 2 percent of the Terai irrigation respectively. While government-developed surface irrigation systems are capital intensive, with permanent diversion and crossing structures, and relatively elaborate distribution networks, the farmers' systems are simple, indigenous, labour intensive and use temporary diversion structures. Flood damage, washing away of canal ridges (by landslides or floods), breach and subsidence of canals are frequent problems in the latter systems, resulting in recurrent supply interruptions. The farmers in the successfully-run communal systems, on the other hand, have in-built mechanisms to minimize these problems. However, these schemes, which dominate irrigation in Nepal, are a potential area for improvement.

1.3 Irrigation Management Problems

Irrigation development in Nepal is beset with numerous problems. Most emanate from institutional deficiency and from an inappropriate approach to irrigation development. The planning, designing and contract administration capability of Department of Irrigation, Hydrology and Meteorology (DIHM) has left much to be desired. A viable and efficient local contracting construction industry has yet to be developed. Planning for logistics is virtually unknown. Shortage of construction materials and explosives is a recurrent phenomenon. While delay in project implementation is often associated with problems related to contracts and material availability, the operational difficulties faced by some of the irrigation projects are attributed to faulty design and construction. Emphasis has been placed on head rather than tail regions. Similarly, lack of coordination among the agencies involved in agriculture devel-

opment is a chronic problem adversely affecting irrigation performance. Fund availability is not a problem in itself, but inefficient financial management has often caused cash flow difficulties. Organizational rigidity and human behavioural problems have also contributed to the less-than-satisfactory performance of irrigation projects.

Engineering has been over-emphasized in irrigation development. Emphasis has been placed on the construction of major structures such as diversions, canals and river crossings. Utilization aspects have received scant attention. The concept of water management is of recent origin and has been introduced in some of the large aid projects. In these projects, too, the main focus has been on on-farm development. The human element has not been given due priority. Consequently, utilization of the irrigation projects has suffered and they have not brought their expected benefits.

1.4 Irrigation Improvement Projects

Although efforts at finding solutions to the complex problems of irrigation have been continuing, an appropriate model for irrigation development has not yet been devised. Different approaches have been tried. Worth mentioning are the Farm Irrigation and Water Utilization (FIWUD) approach of the Department of Agriculture (DOA), and the Command Area Development (CAD) approach of DIHM that take a total view of irrigation with emphasis on system utilization. These two approaches differ in the level and degree of farmers' participation and also in the mechanics of farmers' involvement and project implementation. While FIWUD involves farmers from the very inception of the project concept with the Government institution playing a subordinate role throughout, the CAD approach provides a lead role for the Government institution and the farmers are involved only at appropriate stages for specific tasks. The FIWUD approach has been initiated on a limited scale only recently. The CAD approach, on the other hand, has been under implementation for quite some time in big projects such as the Narayani Irrigation Project. It has recently played a dominant role in the national irrigation development programme. Implementation of these programmes has been accompanied by efforts to strengthen institutional capability by staff development and organizational streamlining.

2. PROGRAMMES TO INVOLVE FARMERS

2.1 Farmers' Participation and Organization

Farmers' participation is a new phenomenon in Government irrigation projects, though it has been an integral part of communal irrigation systems. The concept was first incorporated in large projects only in the 1970s. Its area of application has been gradually expanded covering even small FIWUD schemes. "Water Users Group" is the mechanism for farmers' participation.

Varied forms of farmers' organizations are provided for different projects, and clear and coherent thinking is lacking. In the Narayani Irrigation Project, there is a tertiary-based, two-tier organization, and the beneficiaries served by each division box form a grass-roots water users group. The members of the group elect their leader who maintains liaison with the project authority for operation and maintenance of watercourses and field drains. Water distribution (within the tertiary blocks) is also carried out by the group. Members of the group are duly registered with the project. The same organizational pattern is followed in the Mahakali Irrigation Project except that the organizations are registered under the Cooperative Act. In the Kankai Irrigation Project, there is a complex hierarchial multipurpose organization similar to a cooperative.

In the FIWUD programmes, small irrigation projects are initiated by the beneficiaries who make a formal request to the FIWUD through the District Agriculture Office or the District Panchayat - the political organization at the district level. Technical assessment of the request is followed by the formation of a Construction Committee from the beneficiaries that implements the project in close cooperation with and technical supervision by FIWUD staff. The projects are jointly financed by the Government and the beneficiaries. Seventy-five percent of the cost is borne by the Government and the rest is contributed by the beneficiaries. Five percent of the contribution must be in cash to be deposited in a bank in advance in the name of the project as a commitment of the beneficiaries to the project. After completion, water users groups take over the entire operation and maintenance of the project with technical assistance, whenever needed, from the Regional FIWUD office.

Progress on the formation and func-

tioning of Water Users Groups has, however, not been encouraging. Only the Narayani Irrigation Project has made some progress with the formation of 485 Water Users' Associations and 2168 Water Users Groups. The absence of an effective mechanism and approach for forming such groups, together with a lack of interest among the project staff, are the major factors responsible.

2.2 Strategies to Involve Farmers

Nepal appreciates the need to involve farmers in irrigation development. Farmers should be the focus of agricultural development. This philosophy has found its expression in the recently promulgated Decentralization Act of 1982. This provides for a District Secretariat headed by a District Chairman, comprising district offices of sectoral ministries. The secretariat prepares a District Development Plan and provides coordinated services for the farmers through service centres and user groups. Water user groups have been institutionalized in the Act by requiring all local development projects to form users' groups among the beneficiaries. The group has been provided with wide-ranging responsibilities and rights including a right to levy tax. However, the act has not yet become operational. But the Government is committed to implement it with the launching of the Seventh Plan (1985-90). Detailed rules for its effective implementation are in the making. It is hoped that the act, its by-laws and rules, will make farmers' participation in the development process a reality.

2.3 Linkages

The absence of effective coordination between DIHM and agriculture-related agencies, particularly the DOA, has been a chronic problem in agricultural development. Linkages between the two departments at the policy, programming and implementation levels are almost nil. This is partly because the two departments are under different ministries and also partly because they are being looked after by two divisions of the Planning Commission at the programming level. Likewise, at the donors' level, particularly in the World Bank and the Asian Development Bank, the same type of organizational structure exists. As a result, unified decision making is conspicuously absent at all levels.

The Ministry of Agriculture has, in recent years, initiated a concept of "coordination through programme" for which a unified annual production programme is prepared at the ministry level, and the respective agencies incorporate the necessary elements into their annual programmes. Coordination between irrigation and agriculture is based on irrigation facilities provided by DIHM, where all inputs including water are supplied in an integrated manner. Preparation of a Special Economic Programme jointly by MOA and DIHM has also reinforced this process. Consequently, the situation has slightly improved. But without unified monitoring and supervision, not much can be expected. And there is no formal body whereby people working both at the policy and operational level can be brought together to thrash out problems.

3. ASSESSMENT OF SYSTEM PERFORMANCE

Results of farmers' involvement in terms of water distribution, system maintenance, water fee collection, and productivity have not been documented. However, it is claimed that wherever water users groups are functioning properly, visible improvements in the operation, maintenance and productivity are evident. The Director General of the DIHM reported recently that operation and maintenance expenditure has reduced substantially in the projects where water users groups started functioning. These groups have also been proved effective in solving conflicts. The net result is that crop productivity has increased. In the Narayani Irrigation Project, where water users groups are functioning well, the yields of late and early paddy are 3.28 t/ha and 3.52 t/ha, significantly higher than those in other irrigation projects (2-2.5 t/ha) - an increase that can partly be attributed to the farmers' involvement in the project.

Similarly in the FIWUD programme, under which 14 schemes serving 783 ha in two districts have been completed, it is said in the Department report that beneficiary farmers have contributed Rs 670 000 for construction alone. Because of their involvement in the entire activities of the project from the beginning, cropping intensity increased from 125 to 200 percent. Productivity has also increased significantly and, as a result, annual incremental benefits of Rs 4 034 000 have been reaped.

4. EVALUATION

4.1 Effectiveness

Though the factors contributing to

larger involvement of farmers are difficult to identify in the absence of empirical studies, some possible determinants can be suggested. Adequate provision of physical infrastructure and an assured supply of water seem to have played a positive role. Organizational structure, staffing pattern and staff orientation may be crucial. Awareness on the part of the farmers, their entrepreneurial quality, and homogeneous socio-economic characteristics are also contributory elements. The better performing Narayani Irrigation Project has reasonably good provision of tertiary services, a fairly adequate water supply, satisfactory number of agriculture staff under the direct command of the autonomous project organization, and relatively well informed farmers. Similarly, FIWUD projects are oriented to establishing linkages with farmers.

4.2 Constraints

Many factors prevent farmers becoming more involved in in irrigtion systems. Central among them is the lack of an appropriate mechanism or model for developing farmers' organization. A clear and definite understanding of the process of organizing farmers and the means for managing these organizations has not yet been developed. As a result, varied approaches, seemingly of experimental type, are in vogue (or are being proposed in feasibility studies). Other major constraints include lack of adequate resources and manpower, organizational rigidity and bureaucratic orientation, and a resigned or dependent attitude among the farmers.

4.3 Specific Issues

For successful irrigation development and utilization in Nepal, two crucial questions have to be answered. What is the appropriate mechanism for evolving farmers' organization? And what mechanism can be used to improve and expand the farmers' systems without destroying the existing organization?

Extensive investigation of successful farmers' managed irrigation systems is expected to provide an indigenous farmer organizational model. This faith is based on the available evidence which suggests that there are many organizational elements in the farmers' managed irrigation system from which much could be learned and which could provide a generalized model for farmers' organization.

APPENDIX

A NOTE ON FARMERS' MANAGED IRRIGATION SYSTEMS

(From "Some Observations on Irrigation Development in Nepal", presented at a Water Management Seminar, Kathmandu, 1983, by Thakur N. Pant and Jyoti P. Lohani.)

a. Farmers' managed irrigation systems or communal irrigation systems are need-based and the initiative for organizing them has invariably come from farmers themselves.

b. Communal irrigation systems are management intensive. Technical deficiencies of the systems have largely been compensated for by intensive management, backed by flexible and strong organization.

c. Organizational structures are largely determined by the size and needs of the systems. Complex hierarchial and decentralized organizational structures have also been devised whenever necessary. Even advanced forms of organization embodying some features of a joint stock company are found.

d. Though many communal irrigation schemes are small, no in-built bias towards smallness was established. There are schemes with an irrigated area as large as 15 000 hectares. The size of the river source and the extent of resource requirements determe the size of systems.

e. Members of communal irrigation systems usually exercise some sort of property right or membership in the systems. Sellin water or selling shares or charging relatively higher fees (than justified by canal expansion requirements) to the latecomers were noticed.

f. Communal irrigation systems are dynamic - they are continually improving and expanding. Their service areas are usually determined by hydraulic boundaries. But one study found the original farmers' scheme in the present Gaguri Irrigation Project to be regressive, that is, monopolized by the few households which initiated the schemes. Given the ownership of the system, the existence of regressive schemes cannot be ruled out if there are no mechanisms to benefit the original developers when improvements are made.

g. Even in a small area, many independent communal irrigation schemes, sometimes using the same river, are found. Households sometimes have multiple memberships because their land falls under different schemes. When government undertakes projects in such an area, it invariably combines these individual schemes. The technical difficulty of tapping enough water to supply the entire command, the difficulty of transporting it great distances, and the inability to forge a homogeneous group explain this phenomenon to a large extent.

h. Many different kinds of leadership are found among the projects. One comon feature is that leadership is accountable to members in all the schemes. The decision-making pattern often confirms the local socio-economic situation. Political organizations have roles only in some schemes.

i. Community organization is based on local resources and, therefore, is labour intensive. Modern construction materials are used only in a few cases, and that has been for some specific purposes such as use of pipes in a landslide zone. All the components of the production package - the canal system, agriculture technology, organization and management, and the resource base must be consistently matched.

IRRIGATION WATER MANAGEMENT IN PAKISTAN

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1. INTRODUCTION

Pakistan is basically an agricultural country blessed with immense natural resources such as favourable climate, fertile plains, vast irrigation land and considerable manpower.

It is an arid to semi-arid country with a total area of 79.61 million hectares, administratively divided into four provinces: Punjab, Sind, NWFP and Baluchistan. The total population is about 88 million, of which about 75 million live in the rural areas.

Agriculture contributes 29 percent to GDP and provides employment for about 55 percent of the labour force. Moreover, 70 percent of the country's exports originate from agriculture which therefore acts as the backbone to the country's economy.

About 44 percent of the country is estimated to be suitable for agriculture, out of which 20.26 million ha are cultivated, 2.78 million ha are forest and 11.68 million ha are culturable waste. The cultivated area includes 14.8 million irrigated hectares and the remaining 5.47 million ha are barani (rainfed and riverain). The total annual cropped area is 19.3 million ha including 3.75 million ha which are double cropped, while 15.55 million ha remain fallow during one season. The country has long been self-sufficient in wheat and rice, the staple cereals. The major cash crops such as cotton and sugarcane are partly exported.

2. THE IRRIGATION SYSTEM

The Indus Irrigation System which developed over more than one hundred years, is the largest continuous irrigation system in the world. It covers an area of 16 million ha of which 88 percent is cultivable. It comprises the Indus and its major tributaries, three large dams (Tarbela, Mangla and Chashma) with a storage capacity of 18.6 billion cubic metres, 48 principal canals emerging from 20 barrages/head works and 89 100 watercourses. Many of the canals are large, 15 of them having a capacity of more than 280 m^3/s. The total operating capacity of these canals is 7323 m^3/s with an annual conveyance of 231 billion cubic metres.

The total length of canals is 63 000 km, with watercourses, farm channels and ditches running for another 2 million km. The capacity of watercourses is between 28 litres to more than 112 litres per second and generally 60 to 240 ha are commanded by each watercourse. The flow of watercourses is governed by an open outlet or "Mogha". Watercourse outlets are generally spaced at an interval of 1 to 1.5 km on distributaries and minors. While the main and branch canals are sufficiently controlled by structures to enable them to carry flow from 10 percent more to 60 percent less than the designed flow in such a way that each watercourse outlet receives a constant discharge, until the distributary flow drops to about three-quarters of full capacity. When this flow cannot be maintained due to shortage of water in the main canal, a system of closure of distributaries is put into effect by rotation so that available supplies are equitably shared between distributary/canal commands. Under this system, a minor and its watercourses can operate either at full supply level or be closed; there is no intermediate stage of regulation.

The distribution of water within a watercourse command is by a time rotation system called "Warabandi" with each farmer holding a specific time period usually every seven days in proportion to the size of his holding. The rotation of turn begins at the field closest to outlet and farmers take their specified turns and pass water on to the next farmer until the last farmer has received his turn. Allotment schedule of turns is decided by farmers or sometimes by the Irrigation Department.

The construction, operation and maintenance of the watercourses and other irrigation channels are the responsibility of the farmers. Because of poor farmer cooperation and inadequate technical assistance, these watercourses have deteriorated, resulting in excessive delivery losses. Hence the farmers in the mid and tail reaches generally receive considerably less water than their planned share. The 1863 Canal and Drainage Act provides sanctions for the Department of Irrigation to assure adequate maintenance of the watercourses by the farmers, but it has never been enforced.

Water supply to the canal system is governed in most areas by the supply available in the river system rather than by actual crop water requirements.

There is five times more water in the rivers in summer than in winter. Storage at Mangla, Tarbela and Chashma reservoirs provides some opportunity to regulate the utilization of the river flow by storing the water during summer and releasing it in winter. It

Table 1 WATER RESOURCES POTENTIAL AND PRESENT WATER AVAILABILITY

Source	Water available (billion m³) Canal head*	Watercourse head	Irrigation field	Crop use
Surface water	171	145 (85%)	131 (90%)	111 (85%)
Groundwater	-	62	56 (90%)	47 (85%)
Rainfall	-	-	-	16
Total	171	207	187 (90%)	174
Present water available				
Surface water	126	94 (75%)	52 (55%)	41 (79%)
Groundwater	-	41	20 (48%)	16 (79%)
Rainfall	-	-	-	10
Total	126	135	72 (53%)	67

* Average river inflow

is estimated that about 10.8 million ha is presently irrigated by canals.

In addition to this grand Indus irrigation system, there are about 1 181 200 private tubewells with average capacity of 30 l/s each and 14 000 public tubewells of designed capacity of 60 to 120 litres per second each. At present, these tubewells pump about 45 billion m³ water and provide 37 percent of total irrigation water to exclusively 2.7 million ha in addition to supplementing some canal-fed areas. Tubewells pump the water directly into watercourses and field channels.

3. IRRIGATION MANAGEMENT PROBLEMS

The irrigation system of Pakistan can be divided into two parts, Part I or the Upper Part lies above the watercourse outlet and consists of canals, distributaries and minors. The maintenance of this part is the responsibility of the government (Irrigation Department). Part II or the Lower Part consists of watercourses and field channels which lie below the watercourse outlet. The farmers of the relevant watercourse are responsible for the maintenance of this portion of the irrigation system. Except for a few canals, most of the conveyance system of irrigation water is unlined. With the passage of time, the system has deteriorated, resulting in substantially reduced delivery efficiency and high water losses.

3.1 Losses in Canals and Distributaries

Water losses in canals and distributaries depend mainly upon discharge, length, soil type, sediment in water, vegetation and maintenance conditions, etc. Most research workers and experts agree that in Pakistan the delivery efficiency of canals and distributaries is about 75 percent. On this assumption, it is estimated that about 32 billion m³ of water are lost annually in the canals, distributaries and minors.

3.2 Losses in Watercourses

Research by CSU/WAPDA in 1973 at Mona Reclamation Experimental Station, Pakistan (MRES), indicated that the operational losses in the watercourses were as high as 31-57 percent against 11-20 percent assumed in irrigation designs. These losses were greater in the Salinity Control and Reclamation Project (SCARP) area. In 1976, a survey of 40 sample watercourses in Punjab and Sind by MRES determined conveyance losses between 35 and 67 percent, with a mean conveyance loss of about 54 percent. Another study, carried out on 61 selected watercourses during Rabi and Kharif seasons in 1977 by the Perspective Planning Division of WAPDA in all the four provinces, indicated irrigation efficiencies as 37 percent for Sind, 42 percent for Baluchistan, 46 percent for NWFP and 51 percent for Punjab.

Based on an average 46 percent conveyance loss, it is estimated that 64 billion m³ water is lost in watercourses. These losses are due to a variety of reasons, such as poor maintenance, seepage, over topping, dead storage, leaky junctions and turnouts.

3.3 Application Losses

The losses from the field are mainly due to poor lane levelling, and traditional agronomic and agricultural practices. The Colorado State University (CSU) and WAPDA identified field application efficiencies as 79 percent and 70 percent respectively during different studies in 1977-78. If both studies are combined, the average application efficiency comes out at 74 percent. It is estimated that about 20 billion m³ of water are lost during its application in the fields annually.

Table 2 WATER LOSSES IN IRRIGATION SYSTEM AND ITS SAVING WITH ON-FARM WATER MANAGEMENT

	Billion m³
Canal withdrawals (1977-78)	126
Water losses in canals and distributaries	-32
Available canal water at watercourse head	94
Groundwater at watercourse head	41
Total (watercourse head)	135
Water losses on the farm	
Water lost in watercourse (47%)	63
Water lost in field (21%)	15
Total losses on the farm	78
Water saved through OFWM	
Watercourse improvement (90% eff)	42
Precision land levelling (85% eff)	4
Total (savings)	46

4. NEED FOR ON-FARM WATER MANAGEMENT

In the past, the strategy was focussed on increasing water availability in irrigated agriculture and tackling the problems of waterlogging and salinity by adopting curative measures. Thus new canals were constructed and old canals were remodelled to divert more water from rivers. Three large reservoirs (Mangla, Tarbela and Chashma) were constructed and tremendous ground water resources were exploited. But we failed to match the cropped area with the increased water availability mainly due to increased water losses during conveyance and field application. It was recognized that water management must be improved to increase the cropped area proportionately to the water supply.

Crop yields in Pakistan are still very low compared to leading world agricultural countries in spite of fertile land, a large irrigation system and favourable climate. Although many factors contribute to low crop yields, recent experiments have proved that yields can be increased 2-5 times by adopting improved agronomic and irrigation practices.

Another serious problem encountered from poor water management was the menace of waterlogging and salinity. The water table which was about 30 m deep before the development of irrigation system has now reached to within 3 m in nearly 50 percent of the Culturable Canal Command Area (CCCA). Some 32 percent of the CCCA has a water table 1.5 to 3 m below ground level, 17 percent has a water table less than 1.5 m deep in the months of June to October. Nearly 18 percent of the total Canal Command Area is covered by more than 20 SCARPs having 11 200 and 1 260 fresh and saline groundwater tubewells respectively and a network of surface and tile drains. But even in the completed SCARP areas waterlogging and salinity are still not under control. This made us realize that curative measures alone are not a solution to controlling waterlogging and salinity. Preventive measures are required to prevent major

Table 3

WATER AVAILABILITY AT WATERCOURSE HEAD
(billion m^3)

	Canal withdrawals		Groundwater tubewell		Total water at w/c head
	At canal head	At w/c head	Private tubewells	Public tubewells	
1960-61	99.41	74.56	1.87	0.68	77.11
1961-62	102.21	76.66	2.71	0.81	80.18
1962-63	108.80	79.35	3.77	2.82	85.94
1963-64	110.18	82.64	5.10	3.11	90.85
1964-65	110.90	83.18	6.74	3.44	93.34
1965-66	112.56	84.20	8.63	3.58	96.41
1966-67	118.37	88.78	10.70	2.51	101.99
1967-68	116.81	87.61	12.66	2.86	103.13
1968-69	121.26	90.95	14.26	4.09	109.30
1969-70	123.15	92.37	15.65	5.14	113.16
1970-71	107.76	80.82	17.14	6.28	104.24
1971-72	106.88	80.16	19.00	6.50	105.66
1972-73	124.46	93.34	20.54	6.98	120.86
1973-74	118.50	88.88	22.10	7.84	118.82
1974-75	106.61	91.50	25.23	10.09	113.69
1975-76	112.00	91.50	25.23	10.49	127.22
1976-77	119.89	89.92	26.64	11.70	128.26
1977-78	125.92	94.44	28.06	12.93	135.43
Percentage increase since 1960-61	27%	27%	140%	180%	76%

Table 4

EXTENT OF WATERLOGGING AND SALINITY
(million ha)

Province	GCA	CCA	Waterlogged area		Total	Salt affected area			Total
			0-150 cm	150-300 cm		Moderate saline	Severe saline	Saline alkali	
Punjab	9.31	8.21	1.18	2.64	3.82	0.41	1.21	2.10	3.72
Sind	6.95	5.10	1.26	1.87	3.13	3.23	1.87	-	5.10
NWFP	0.47	0.40	-	-	0.04	-	-	-	0.04
Baluchistan	0.31	0.25	-	-	0.001	-	-	-	0.04
Pakistan	17.04	13.96	2.44	4.51	6.991	3.64	3.08	2.10	8.90
Present area affected			17%	32%	50%	26%	22%	15%	63%

Moderate saline = ECe 8-15 mmhos/cm
Severely saline = ECe above 15 mmhos/cm
GCA = Gross Canal Command Area
CCA = Culturable Canal Command Area

Source: CMO, WAPDA, 1975.

recharge to the aquifer. This could be achieved through improved farm water management.

Further, if irrigation efficiencies are not increased, more than 40 billion m^3 of water are required for delivery at the watercourse head to meet the present crop water requirements. Sixty-five percent is attainable through limited watercourse lining and improvements being made under on-farm water management (OFWM) programmes. It has also been recognized that it is cheaper to save water through watercourse improvement that to develop a new water supply.

5. IRRIGATION IMPROVEMENT PROGRAMMES

5.1 OFWM Pilot Project

An integrated five-year pilot project with the following components was

launched in 1976 with the assistance of USAID.

a. Improvement of watercourses to reduce delivery losses.

b. Precision land levelling of the fields to permit application of water uniformly to all parts of the fields.

c. Training of farmers in improved crop and water management techniques including optimal water application rates and timing, improved cultural practices, proper seeding and fertilizer applications.

d. Establishment of Water Users' Associations on watercourses to help carry out improvement and maintenance of the watercourse and efficient utilization of available water.

e. Training and encouraging private contractors to help the farmers in watercourse improvement and precision land levelling.

Table 5 PERSPECTIVE PLAN FOR ADDITIONAL WATER DEVELOPMENT UP TO 2000

Programme	Potential yield at farm inlet Billion m³	%	Annual cost at farm inlet (Rs 1000 m³)
Watercourse improvement*	18.9	43	36
Canal remodelling	3.9	8	158
Public tubewells (SCARP)	3.8	8	101
Private tubewells	8.8	20	89
Surface water storage	(5.5)	(13)	-
Kalabagh	5.0	11	138
Thal	1.5	4	170
Chotari	0.6	2	122
Mancher	1.5	4	211
Sedimentation	-3.2	-8	-
Riverine groundwater	3.2	8	162
Total	44.0	100	-

* Simple rehabilitation/reconstruction of watercourses with pacca structures.
Source: Master Planning Division, WAPDA.

The Provincial Agriculture Departments were responsible for execution of the pilot project on the farms and the programme was coordinated by the Ministry of Food and Agriculture through its Water Management wing.

The pilot project covered representative areas of all the four provinces which include different ecological zones, SCARPS and non-SCARP areas, sandy and non-sandy soils and small to medium size farms.

The pilot project was successfully completed on 30 June 1981. During the project period, 1319 watercourses were improved by lining 10-15 percent lengths of watercourses and reconstructing the remaining lengths according to engineering designs with concrete control structures. In addition, about 30 300 ha of land was precisely levelled (±2 cm). The targets and physical achievements of the pilot project are compared in Table 6.

Table 6 TARGETS AND ACHIEVEMENTS OF OFWM PILOT PROJECT

Project Component	Target	Achievement	Percentage
Improved watercourses (nos.)	1 211	1 319	109
Precision land levelling (ha)	174 760	30 300	22
Water Users' Associations (nos.)	-	2 023	-
Number of farmers trained (nos.)	4 642	6 351	137
Number of field teams (nos.)	70	56	80

Although achievements in precision land levelling fell short of the proposed targets, the project did achieve its major objective of creat-

ing a realization among the farmers of the importance and usefulness of the OFWM programme.

The experience gained from the pilot project enabled us to try alternate approaches in watercourse improvement, precision land levelling, and dissemination of improved crop and water management techniques. More suitable approaches for different situations were identified and are now utilized in on-going OFWM programmes in the country. These include:

a. The limit for lining percentage of watercourses was increased from 10-15 to 15-30 percent, to 15 percent for Fresh Ground Water (FGW) zones and to 30 percent for saline groundwater zones and sandy areas.

b. To reap rapid benefits with low cost, a crash programme of watercourse improvement was introduced. It includes improving watercourses by heavy cleaning, resectioning and realigning, and installation of concrete puccas (turnouts) with labour provided by the farmers.

c. Demonstration plots were planned at each watercourse to disseminate the benefits of OFWM to the adjoining farmers.

d. Farm management plans were introduced to evaluate the programme at farm level.

e. Subsidy on PLL component was withdrawn by the Government keeping in view the farmers' enthusiasm and response to this component.

f. A sophisticated drip/trickle irrigation system was envisaged on an experimental basis in Baluchistan.

g. Installation of tubewells at the head of improved watercourses for various situations were envisaged in the programme to increase the water availability and to demonstrate the conjunctive use of water at the farm level. This component would also help to reduce or reverse the long-term rise in groundwater levels and reduce the process of waterlogging and salinity.

h. To make Water Users' Associations more effective and beneficial, legislation was enacted in 1981.

After the success of the pilot project, modified regular OFWM programmes were initiatd in all the irrigated areas of Pakistan with the assistance of the World Bank and the Asian Development Bank.

5.2 OFWM Project (IDA/IFAD financed)

This project was initially for three years (July 1981-1984) but has now been extended for one year up to 30 June 1985. The total cost of the project is Rs 1 104.6 million. The details of the targets and physical achievements up to December 1983 are indicated in Table 7.

Table 7 TARGETS AND ACHIEVEMENTS OF IDA/IFAD FINANCED OFWM PROJECT

Item (no.)	Targets	Achievements			
		1981-82	1982-83	1983	Total to Dec. 83
Watercourse improvement/renovation	2 065	440	812	359	1 611
Accelerated watercourse improvement	16 500	2 830	5 124	1 320	9 274
Precision land levelling (ha)	1 487	3 771	4691	1 964	10 426
Demonstration plots	1 723	162	898	524	1 584
Water storage tanks	37	8	12	21	41
Water Users' Associations registered	18 565	1 029	2 158	744	3 931
Training	2 869	1 941	1 762	829	4 532

5.3 OFWM Project (ADB financed)

The ADB-financed project is a four-year project (July 1981 to June 1985), located in one of the districts of Punjab province, and in one in the district of NWFP, at a total cost of Rs 443.87 million. The details of the targets and achievements in Table 8.

6. FARMERS' PARTICIPATION

Farmers have been given full participation in the OFWM programme as members of Water Users' Associations. These Associations are organized and registered at each watercourse prior to improvement under the Water Users' Associations Ordinance of 1981. Since

Table 8 TARGETS AND ACHIEVEMENTS OF ADB FINANCED OFWM PROJECT

Item (No.)	Targets	Achievements			
		1981-82	1982-83	1983	Total to Dec. 83
Watercourse improvement	1 250	128	330	120	578
Demonstration plots	1 250	90	535	87	512
Tubewells installed	950	-	-	-	-
Precision land levelling (ha)	2 519	321	755	345	1 421
Water Users' Associations registered	1 250	163	413	186	762
Training	3540	479	723	447	1 649

there are generally from 15-75 farmers on each watercourse, it is impossible to give detailed guidance to each farmer. Therefore, a Water User Association Executive Committee is selected by the farmers. Generally three or four active committee members representing head, middle and tail sections at the watercourse are selected for the Executive Committee by the farmers in a democratic way. The Executive Committee guides the OFWM project staff in the planning, construction and maintenance of improved watercourses. The duties and responsibilities of the Water User Associations are given below:

- to help plan the works of improvement, including site selection for check structures, turnouts, culverts, buffalo baths, pucca lining and kutcha improvement;
- to resolve land disputes caused by the proposed watercourse realignment;
- to determine the labour assessment per holding;
- to determine the schedule for the watercourse improvement programme;
- to assist in gathering and controlling labourers for watercourse construction;
- to supervise the labourers and provide them with the necessary equipment;
- to encourage those who are late, absent, or whose work is substandard to develop a more positive work attitude;
- to make decisions concerning rescheduling of water when a reach is under construction and the water cannot be used by the normal user;
- to propose essential modifications of the warabandi (scheduling) to the Irrigation Department;
- to establish a watercourse operation and maintenance system; and
- to ensure that good quality work is done, following the National Standards for practices and materials.

Farmers within Water Users Associations are helped to obtain loans from the Cooperative/Commercial Banks for individual improvement, such as PLL, structures, additional lining, installation of tubewells, and for other agricultural inputs such as fertilizer, insecticide and pesticide, and seed.

The performance of these tiny democratic organizations has been satisfactory. These are growing in number and gaining popularity as the most successful cooperative bodies in the history of Pakistan.

Water Users' Associations are making extensive publicity for the project through slogans. Two examples are quoted below:

i. "It is ironic that irrigation water which had been the major source of dispute in the village, became the strongest mediator for cohesion among the farmers."

ii. "It is amazing that the dramatic change in farm production has been achieved with the same water within the same scheduling, with the same land and people."

Such slogans motivate new farmer groups to improve their watercourses and old farmers to maintain the renovated ones properly. Moreover, water disputes have either ended or been minimized.

6.1 Liaison between the Agriculture Department and other Government Agencies

The Irrigation Department is responsible for supplying irrigation water to the watercourse head and Agriculture Departments are responsible for other agriculture inputs, such as improved seed, pesticides. The watercourses are the responsibility of the farmers. Development planning for water resources including surface and subsurface drainage systems to arrest waterlogging and salinity is the responsibility of the Water and Power Development Authority (WAPDA) which also controls reservoir operation to release water for canals. The provincial irrigation departments place their indents to the WAPDA according to their requirements and the water is then released from the reservoirs accordingly. The control of barrages and canals is with the irrigation department, which is responsible for the distribution of water according to the crop season's needs of the different areas. But no institution is really involved with farm level improvement. The On-Farm Water Management Project takes up with farmers' cooperation the farm level improvement in the form of watercourses renovation/reconstruction and PLL, etc.

The On-Farm Water Management Directorates under the Agriculture Department undertake all engineering and physical tasks associated with water within a watercourse command area. The Extension Wing of the Agriculture Department is responsible for combining into the extension package all the non-structural water inputs together with non-water inputs. The OFWM projects strengthen the Agriculture Extension services by providing (a) training for its personnel in the provincial OFWM institutes; (b) lay-out demonstration plots on renovated watercourses for demonstrating techniques to farmers for increasing agricultural production; (c) incremental agricultural supplies of non-water inputs required for such demonstrations. Monthly meetings are arranged between the officials of OFWM and Extension services to encourage coordination and improve input services to the farmers and Water Users Associations.

7. ASSESSMENT OF SYSTEM PERFORMANCE

The involvement of farmers on a large scale in the OFWM project in the shape of Water Users' Associations helped to a great extent to solve the maintenance problems of watercourses in the project areas. The day to day disputes between the farmers have been almost eliminated. The once laborious assignment of irrigation allowances to the crops has now been converted into an easy job.

The project maintenance of the watercourses resulted in an increase of water availability at the farm level. The middle and tail end farmers are now getting their full share of water which prior to the project was mainly wasted during conveyance as a result of poorly managed watercourses. There is seldom any complaint about the shortage or distribution of water, provided the authorized discharge from mogha (outlets) is available.

The responsibility of maintenance of canals, distributaries and minors and drainage lies with the Irrigation Department whereas the watercourses are being maintained by the farmers themselves in the project areas under the supervision of the Water Users' Associations. Recent studies have revealed that "although Water Users' Associations were formed on each of the watercourses, many lost vitality after the watercourse improvement/structures were finished and they reverted to traditional modes of pattern including watercourse maintenance. After post improvement work the Water Users' Associations should be continuously monitored with particular attention directed to their performance in maintaining the watercourses".

8. IMPACT OF PROJECT

The increase in water by minimizing the conveyance losses has made an obvious impact on increasing cropping intensity as well as producing higher yields. Studies carried out at different watercourses have reached the following conclusions and recommendations.

i. The watercourse improvement programme has increased the conveyance efficiency of the watercourse and overall conveyance efficiency. About 23-27 percent of water losses occurring in the main watercourses were saved. The increase in overall delivery efficiency has enabled the delivery of additional water to fields, if outlet discharges are the same. These water savings were achieved by lining an average of 10 percent of the total watercourse length and earthen improvement of 75 percent of the length.

ii. The precision land levelling has yielded significant benefits to

the farmers in the form of additional cultivated area, increased cropping intensity, increased crop yields and saving in irrigation time.

iii. The cropped area within the command area after improving watercourses increased by 2.8 percent.

iv. Cropping Pattern: Changes in the cropping pattern can be seen from Table 9.

v. Cropping Intensity: There has been an increase in overall cropping intensity amounting to 3.7 percent as shown in Table 10.

Table 9 PERCENT CHANGE IN CROP AREAS BY POST-IMPROVEMENT INTERVAL

Crop	Pre-improvement to post-improvement II*	Post-improvement II post-improvement III	Pre-improvement to post-improvement III**
Wheat	-4.2	-3.3	-7.3
Rice	17.5	17.1	37.6
Maize	35.8	-17.2	12.4
Cotton	-12.4	17.8	3.2
Sugarcane	9.6	3.6	13.6
Other crops	6.5	-0.2	6.4

* One cropping season
** Two cropping seasons

Table 10 SEASONAL AND ANNUAL CROPPING INTENSITIES AND CHANGES DURING POST-IMPROVEMENT INTERVALS (percent)

Season	Intensities			Change in Intensity		
	Pre-improvement	Post-improvement II	Post-improvement III	Pre-improvement to post-improvement II	Post-improvement II to post-improvement III	Pre-improvement to post-improvement III
Rabi*	76.8	77.0	73.8	0.2	-3.2	-2.8
Kharif**	54.4	56.2	61.1	1.8	4.9	6.7
Annual	131.2	133.2	134.9	2.0	1.7	3.7

* Winter crop
** Summer crop

vi. Crop yields: Increase in crop yields cannot be attributed exclusively to watercourse improvement but depends on many factors. However, the change in major crop yields has been positive. As shown in Table 11, production rose to 5.5 percent for wheat and to 20.6 percent for sugarcane.

Table 11 PERCENT CHANGE IN MAJOR CROP YIELD BY POST-IMPROVEMENT INTERVAL

Crop	Pre-improvement to post-improvement II	Post-improvement II to post-improvement III	Pre-improvement to post-improvement III
Wheat	0.5	4.9	5.5
Rice	4.1	2.1	6.3
Maize	3.2	11.3	14.9
Cotton	11.8	-31.7	-23.6
Sugarcane	14.5	5.4	20.6

Note: Cotton yields have been reduced by bad weather and pest attack.

vii. Gross Value of Production: Since both yields of the major crops and cropped area have increased, the gross value of production also increased (Table 12).

viii. Ninety-six percent of the farmers have rated the programme useful. More than 80 percent of the farmers reported that water losses have been minimized once the saving in irrigation time was appreciated.

Table 12 CHANGE IN GROSS VALUE OF MAJOR CROPS BY POST-IMPROVEMENT INTERVAL

Crop	Gross value (100 000 Rupees)			Percent Change		
	Pre-improvement	Post-improvement II	Post-improvement III	Pre-improvement to post-improvement II	Post-improvement II to post-improvement III	Pre-improvement to post-improvement III
Wheat	8.20	8.54	8.56	4.15	0.23	4.39
Rice	0.59	0.69	0.69	16.95	0.00	16.95
Maize	0.68	0.75	0.79	8.70	5.33	14.49
Cotton	5.32	5.92	3.85	11.28	-34.97	-27.63
Sugarcane	5.93	7.32	8.59	23.44	17.35	44.86
Total	20.73	23.32	22.48	12.49	-3.60	8.44

KOINADUGU INTEGRATED AGRICULTURAL DEVELOPMENT PROJECT - KABALA, SIERRA LEONE

by

K.M. Kargbo
Koinadugu Integrated Agricultural Development Project
Kabala, Sierra Leone

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1. IRRIGATION MANAGEMENT CONDITIONS

1.1 General

Koinadugu Integrated Agricultural Development Project (KIADP), an arm of the Ministry of Agriculture and Natural Resources, is organized to assist farmers in:

- cattle rearing and ox-traction;
- improvement of crop farming techniques;
- creation of variable input loans;
- development of swamps by better planning of drainage and irrigation structures; and
- the construction of feeder roads.

The project is in the northmost district (Koinadugu) of Sierra Leone, a country on the West Coast of Africa between latitude 70 and 10° North and longitudes 10° 30' and 13° 15' West. The country has a long wet season (April to November) and a long dry season (November to April) during which little or no rain falls. Temperatures are high enough for crops to grow but the unavailability of rain during the dry season necessitates irrigation. The high rainfall in the wet season provides more water than necessary for crops to grow in the swamps. Drainage is therefore required for proper regulation of field water in the swamps.

1.2 Irrigation System

Swamps are of the most suitable environment in which to grow rice, a staple food in Sierra Leone. The irrigation system is therefore centred on swamps only. The method commonly used is surface irrigation by gravity. Mechanical pumping is rare and cannot be effectively and economically handled by farmers.

1.3 Irrigation Management Problems

There are no hydrological data on streams which are the only source of irrigation water. This has produced two problems. First, the size of most of the streams was under-estimated during dam construction in the dry season. During the rains, floods have caused serious damage to these dams. Secondly, some of the seasonal streams were mistaken for perennial streams at the time of development. During adverse dry season periods, the supply of water to field crops has been zero from these streams.

The percentage of illiterate farmers is high and the road network is too poor for the few extension field workers to visit every farm. There is a need, therefore, to improve the supervision of farmers so that modern methods and techniques can be taught and followed by farmers.

These problems are being solved as follows:

a. stream studies are being made during the different seasons;

b. dams are now constructed only after a data collection period of at least two years;

c. farmer training sessions are held at Agricultural Development Centres at least once every month; and

d. a department has been set up to improve old feeder roads and open up new ones so that more and more farmers can be reached.

1.4 Irrigation Improvement Programmes

One of the major irrigation programmes in the country is the Rhombe Swamp Agricultural Development Project. A feasibility study has been completed and the project is expected to be implemented in the near future. Many other drainage and irrigation projects are also being studied.

The World Bank has also agreed to set up an irrigation and drainage unit under the Ministry. This unit is expected to have expatriate irrigation engineers working with local engineers. It would provide advice on the engineering aspects of irrigation and drainage to the Ministry itself, and to all agricultural development projects.

2. PROGRAMMES TO INVOLVE FARMERS

2.1 Farmers' Participation and Organization

Farmers have played an important role in establishing irrigation and drainage schemes. In KIADP, farmers are organized into groups, each of which has a leader. Among other agricultural activities, the groups act as work gangs helping construct irrigation canals, drains and bunds, and level paddy rice plots. The group leaders are the main links between the project and group members.

2.2 Strategies to Involve Farmers

Field days are organized by the Train-

ing Officer of the project in collaboration with the Chief Extension and Land Development Officer. The farmers are taken to different successful farmers' fields and project demonstration farms where they are taught the design, operation and maintenance of irrigation and drainage schemes.

The European Economic Commission (EEC) countries and the Sierra Leone Government provide the funds to run the project. The EEC representative in Sierra Leone, the National Authorizing Officer and the Ministry of Agriculture and Natural Resources supervise the Project Manager and staff in running the project for the farmers. KIADP is an integrated project divided into departments and units, each of which works with farmer groups in various fields, including irrigation and drainage.

Farmers are given two types of loans as support: seasonal loans comprising improved seeds, tools and fertilizers; and development loans, comprising cash for hired labour, and construction materials such as cement, iron rods and boards.

Farmers themselves organize an irrigation water regulation agreement without the intervention of government organizations. This is traditionally done among farmers without even a local authority in the first instance. Where problems arise, the matter is first referred to the farmer group leader. If he cannot solve it, then the local village headman is approached. The Paramount Chief is the last and most powerful authority to settle land and water disputes among farmers. A high degree of cooperation has existed among farmers in KIADP and serious problems are uncommon.

3. ASSESSMENT OF SYSTEM PERFORMANCE

3.1 Water Distribution

The involvement of farmers in irrigation water supply has been simple. Farmers open the intake-sluice and water flows into the irrigation canal by gravity. Water is then led into paddy plots from the irrigation gutter through inlets which can be opened or closed when required.

The availability and fair distribution of water over the years has been much improved as a result of the farmers' involvement. However, periodical problems do arise where several farmers have a common source of water supply to irrigate different farm units.

3.2 System Maintenance

Farmers normally carry out maintenance work with little or no advice from the extention agent in charge of the area. When serious damage occurs, the Land Development Department will undertake the maintenance at project cost. Maintenance has gradually improved due to past experience and the involvement of many farmers in irrigation and drainage schemes.

3.3 Irrigation Water Fees

In KIADP the only money paid by farmers to the project is repayment of the loan given in respect of swamp development. Such loans may be in the form of construction materials or cash for hired labour. The repayment is spread over four years. After the liquidation of the loan no more fees are paid by farmers.

3.4 Agricultural Production/ Productivity

Over a period of five years, high yields have been recorded from fully developed swamps while low yields continued to be reported from undeveloped swamps.

Extract from 1979 to 1984 Yield Records:

Fully developed swamp		
Highest yield per ha	=	3127 kg*
Lowest yield per ha	=	2760 kg
Undeveloped swamps		
Highest yield per ha	=	2373 kg
Lowest yield per ha	=	1545

* Estimated at 1 bushel = 23 kg paddy

However, yields depend on the following factors:

- variety of rice grown;
- water regime of the swamp;
- type of soil;
- timely planting; and
- agronomic care such as fertilizer application, weeding, control of rodents, birds and insect pests.

Under irrigation schemes it has been possible to grow two or three crops of rice per annum. A good cropping calendar, if strictly followed, helps to achieve goods yields.

4. EVALUATION

4.1 Effectiveness

The factors that have helped involve farmers in irrigation scheme operation and performance include:

i. high yields from developed swamps;

ii. financial assistance (loans) to farmers by the project; and

iii. availability of variable inputs as loans to farmers such as tools, improved seeds, fertilizer, transport, and technical advice from irrigation officers and agro-extension agents.

4.2 Constraints

The main factors preventing a larger involvement of farmers are:

i. high level of illiteracy among farmers;

ii. low power on the farm, mainly limited manpower which is becoming scarce and expensive;

iii. a poor road network which impedes frequent farm calls;

iv. poverty among farmers which prevents large-scale farming; and

v. inadequate staff to supervise farmers.

4.3 Specific Issues

KIADP is one of many integrated projects involving irrigation and drainage schemes within the country. The irrigation and drainage programme includes the following staff:

- one Chief Land Development Officer based at headquarters;
- one Senior Surveyor who assists the above;
- six Agricultural Surveyors each heading irrigation and drainage schemes within a chiefdom; and
- fourteen Surveyor Assistants who supervise day to day earth moving and other operations in the swamps.

Loans are recommended through a Farm Inspection Certificate (FIC) by the Land Surveyor to the Chief Land Development Officer who periodicially checks on each scheme before approving the loan. If a loan is approved, the FIC is then sent to the Accountant for preparation of all necessary documents in collaboration with the Commercial Services and Extension Officers' recommendations. Loans are finally disbursed to farmers in the form of either a seasonal loan, repayable within a year with 20 percent interest, or a development loan, which is repayable over five years with one year grace period, and has an interest rate of 15 percent charged over the entire period of repayment. Under this programme, only small farmers are assisted as commercial rice farming is not common in the country. About 180 farm families are being assisted in this way. The total area of these farmers is 255.1 ha.

NONG WAI PIONEER AGRICULTURE PROJECT, KHON KAEN PROVINCE, THAILAND

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1. IRRIGATION MANAGEMENT CONDITIONS

1.1 Introduction

Nong Wai Pioneer Agriculture Project (NWPAP) was conceived in 1969 by the Committee for Coordination of Investigation of the Lower Mekong Basin and the Government of Thailand as the first comprehensive plan for irrigated agricultural development in the Mekong Basin. The Government has granted high priority to the Project as an important element in the development of northeast Thailand, the least developed region of the country.

NWPAP was begun in October 1975 as the first land consolidation project in the north-east region with a loan of US$ 5.0 million from the Asian Development Bank.

The project aimed at increasing agricultural production and stabilizing the economy of farm families in the 12 000 ha area in and around Khon Kaen City through rehabilitation of the main irrigation and drainage system and provision of complete on-farm facilities, coupled with the introduction of double cropping of rice, more intensive extension services and agricultural cooperatives. The area was to be set up as a model for intensive agricultural development in the region.

For this purpose, the Government had formulated an ambitious integrated development plan covering not only paddy and upland crop cultivation but also demonstrations for fish culture and livestock raising in the area to help increase farmers' living standards.

1.2 Description of the Project Area

The Project is located in Khon Kaen province and has a command area of 10 000 ha which is served from the Nam Pong weir on the Nam Pong river.

The climate in the project area is tropical with monthly average temperatures ranging from 22.5°C in January to 30°C in May. Annual rainfall averages about 1200 mm and is characterized by a pronounced seasonal distribution with more than 85 percent of rainfall occuring in the period from May to October.

The soils in the project area are of alluvial origin, mainly heavy clay and sandy loam. The heavy clay soils are acidic, of moderate fertility, low organic matter, poor drainability and with groundwater 2 m below surface covering about 7000 ha of flat lowlands. The sandy loam soils over sandy clay loam cover an area of 5000 ha and have low organic matter, moderate drainability and permeability with groundwater 2 m below surface during most of the year.

1.3 The Irrigation System

Water for irrigation is provided from the Upolratana Dam on the Nam Pong river, which has a storage capacity of 2550 million m³. In the dry season adequate water is available for 80 percent of the years. During the wet season there is normally no problem.

A summary of the upgraded irrigation facilities is provided in Table 1. The construction work under the project included rehabilitation of 58.2 km of lined lateral canals and the construction of 22.1 km of new laterals in ditch improvement areas.

Work on improvements to the drainage system was begun in 1978 and included several routes of natural drains, the 8.4 km Huai Yai drainage excavation and the 10.8 km Huey Pla Lai drainage route which was begun in September 1980.

Erosion is a problem in many drainage channels due to steep slopes and the abience of structures at the end of drains. These problems may escalate in future.

A flood protection dyke was scheduled to be constructed during 1980-81 to protect low-lying land in the southern part of the project. This was to comprise 9.5 km of feeder road and 18 km of new embankment along the Nam Chi River. Construction work began in August 1982 and was scheduled for completion in September 1983.

1.4 On-farm Developments

Construction of on-farm development works was undertaken in 1976 and 1977 using existing Royal Irrigation Department (RID) equipment. On the basis of this experience it was decided that for about half the area intensive land consolidation works would be carried out and for the remaining area "extensive" ditch improvement works.

A number of problems was encountered in implementing the on-farm development works. The contracts for land consolidation work required at least six months lead time for the awarding of contracts and difficulties were experienced in preparing the necessary documents sufficiently far in advance to ensure contractors could begin at the commencement of the dry season. In most cases the contractors did not

Table 1 SUMMARY OF PROJECT FEATURES AS IMPLEMENTED

	Unit	As Appraised	As Implemented	
Service Area				
a. Gross area	ha	15 000	15 000	
b. Net area	ha	11 970	10 700	
Main Irrigation Facilities				
a. Enlargement and improvement of existing main canal	km	32	32	
b. Improvement of check structures:				
- in main canals	no	8	8	
- in lateral canals	no	17	17	
c. Enlargement of elevated flume	km	-	3.3	
d. Improvement of existing laterals		na[1]	58.2	
e. Construction of new laterals		na	22.1	
Main Drainage Facilities				
a. Main and secondary drains	km	61.3	68.7	
b. Drainage structures	no	-	38	
Terminal Facilities			LC	DI
a. Land consolidation	ha	11 970	4 986	5 714
b. Turnout intensity	ha/unit	-	70	34
c. Turnouts	no	-	76	167
d. Farm ditch intensity	m/ha	-	52	72
e. Farm drain intensity	m/ha	-	41	19
f. Farm road intensity	m/ha	-	51	21
Flood Protection Dyke	km	27	25	
Roads and Bridges				
a. Feeder, access and service roads	km	145	Improvement	- 106
			New	- 22
b. Bridges: across main canal	no	8	10	
across lateral canals			11	
across main drains			8	

[1] na = not available

have adequate capability, in terms of equipment and experience, to achieve the required standards for land levelling.

Force account works were plagued by difficulties of scheduling all the necessary inputs at the correct time. On a number of occasions, the necessary equipment and budget were available, but shortages of fuel and construction materials occurred during peak construction periods. However, work under force account is generally of better quality than that done by contractors. For on-farm development in general a shortage of experienced RID construction engineers to supervise work quality and output, particularly in the early stages, was another constraint.

The most important change in the design of the project was the decision not to implement land consolidacion work for the whole project area as originally planned. Initial construction work on sample areas revealed that the topography in certain areas would render the cost of extensive land levelling and consolidation prohibitive. It was, therefore, decided that land consolidation work should not be carried out in areas where land levelling would require the movement of more than 500 m per ha. Also the lowlying land in the southern part of the project was excluded from land consolidation because of its frequent inundation. In these areas, amounting to approximately 52 percent of the area, ditch improvement work was carried out which provided irrigation ditches and structures, improved drainage and limited road access to existing field boundaries and levels.

The actual total project cost is approximately US$ 25.858 million against the original estimate of US$ 14.6 million, a cost over-run of 77 percent. This was due to a 209 percent increase in the cost of rehabilitation works and a 176 percent increase in the cost of on-farm development. Other cost over-runs were building construction (447 percent), design and supervision (33 percent) and agricultural advisory services (67 percent).

2. IRRIGATION IMPROVEMENT PROGRAMME

Evaluation of the NWPAP carried out in 1980 showed that progress with agricultural development had been slow, partly because of lack of adequate Government support for credit, farm inputs, extension, marketing and efficient water distribution. The Government then requested technical assistance (TA) to strengthen the Government agencies in charge of the operation. The assistance was formulated under a new loan agreement with the Asian Development Bank (ADB) and approved in December 1980 as the Nong Wai Management Project. The project had five objectives:

i. the establishment of a systematic water management programme;

ii. improvement of agricultural extension services;

iii. strengthening the Nong Wai Agricultural Cooperative (NACS);

iv. training of farmers and NWPAP staff; and

v. strengthening and institutionalizing of a Project Benefit Monitoring and Evaluation System (PBME).

One lateral system covering 800 ha was selected to demonstrate improved irrigation management, including water management, improved crop technologies, and intensified extension and cooperative services.

Three experts were recruited for the project. They specified constraints on achieving the goals of NWPAP and advised and assisted the agencies concerned on the specific measures which should be taken to overcome these constraints. The total cost of the Project was estimated at US$ 451 000. Project implementation of the NWIMP commenced October 1981.

The major accomplishments of NWIMP included a substantial increase in dry season cropping. In 1983 up to 80 percent of the area was cropped during the dry season.

NWIMP also assisted agency staff in preparing an agricultural development programme for 1983-87 and this, together with the recommendations of the various consultants, has been incorporated into an Operation Manual for Irrigated Agriculture for the guidance of NWPAP staff. The various training programmes undertaken by NWIMP included farmer training and project staff training. Approximately 3700 farmers and 108 staff participated.

The institutionalization of a monitoring and evaluation system has not been achieved due to deficiencies in the overall project design. The current system is isolated from project management and it has not been able to provide timely and practical recommendations for improvements to project design or implementation.

3. PROGRAMME TO INVOLVE FARMERS

3.1 Farmers' Participation

The development programme effectively incorporates the farm people into the implementation process. The Government agencies have taken over the responsibility and action for complete construction and implementation of the irrigation scheme. Experience has shown that construction works at farm level cannot be left to the farmers.

The Royal Irrigation Department carries out planning and construction down to farm level. The farmers of the area, of course, should be approached and encouraged to contribute labour but all required funds have to be provided from Government resources. The Government authorities, furthermore, initiate the operation of the project, assisting the farmers in organizing associations and cooperatives, and conveying the technical knowledge and training for successful irrigated agriculture.

It is important to combine and coordinate all the efforts and resources which are being mobilized. It will certainly take a number of years for the farmers to assume responsibility for operation and maintenance of the works

The Nong Wai project gained valuable information about the farmers' responses to the new farming system. Such information will benefit the farmers as well as relevant Government authorities and other agencies.

3.2. Farmers' Organization

The two major organizations to involve farmers in the NWPAP are the Water User Groups (WUGs) and Farmer Cooperatives.

So far, 169 WUGS have been formed. Proposals are being prepared for financial assistance to the WUGs in order to purchase office and transport equipment and to cover operating expenses for an initial one year period. By collecting "maintenance fees" from the farmers, the maintenance and repair of on-farm facilities

will be ensured. Also the distribution of water will be done by the WUG with the help of RID.

The Government also agreed to the formation of one multipurpose cooperative, the Nong Wai Agricultural Cooperative Society Ltd. (NACS), which was set up in 1977. At the end of fiscal year 1982-83, the NACS has 51 cooperative groups comprising 2240 members with loans outstanding of ฿9.4 million (US$ 0.5 million; 1 Bath = US$ 0.05). Table 2 shows selected activities of the NACS. The cooperative is on its way to becoming a viable organization, although several problems remain, in particular the low level of repayment, which threaten its financial viability.

Table 2 SELECTED INDICATORS OF NACS ACTIVITIES (as at 31 March 1983)

Indicator	Number/Value
Number of cooperative groups	51
Number of household members	2 420
Number of members trained[1]	1 023
Short- and medium term loans to members during fiscal year	฿ 5 106 143
Outstanding loans to members of the cooperative	฿ 9 430 063
Loan collection of NACS from its members	฿ 4 848 594
Sales of consumer goods	฿ 462 690
Capital shares value	฿ 1 419 900
Amount of deposits	฿ 264 660
Sales of farm inputs (fertilizers, insecticides, etc.)	฿ 1 022 689

[1] as at October 1982

Source: Nong Wai Agricultural Cooperative Society Ltd.

3.3 Support Services to Farmers

A key objective of the NWPAP was the promotion of integrated agricultural support services to serve all farmers in the project area. No less than eight different agencies were involved in the provision of these services. The main agencies, the Department of Agricultural Extension (DOAE) and the Department of Cooperative Promotion (DCP) who together with the RID provided the Project Managers for the project. The other agencies appointed Project Officers who were responsible for coordinating the inputs to the project.

The extension service (DOAE) is responsible for:

- promotion of crops and cropping systems;
- dissemination of information to farmers;
- field extension agents and farmer training;
- comparative studies on trial plots;
- prevention and control of pest and disease outbreaks;
- demonstration plots and demonstration areas; and
- monitoring and evaluation of progress in agricultural development.

In 1980 extension services were reorganized under the World Bank sponsored National Agricultural Extension Project (NAEP), introducing the training and visit system of agricultural extension. There has been an impressive increase in the use of new varieties and steady increases in the use of fertilizer, herbicides and pest control. In the past two years direct seeding has been rapidly adopted for rice.

The role of the Department of Cooperative Promotion (CPD) was to assist in forming one multipurpose cooperative and to form, organize and strengthen water users' groups. It was successful in forming the cooperative society of Mong Wai and has been active in the promotion of the water users' groups.

Other government agencies involved in the NWPAP are the Bank of Agriculture and Agricultural Cooperatives (BAAC) and the Departments of Agriculture (DOA), Livestock, Fisheries and Land Development.

3.4 Coordination of Government Agencies

The original project structure with a

joint project management provided from the different agencies has not worked in practice. Coordination at the field level was dependent on informal contacts between the project managers. However, no management structure existed with responsibility for overall project planning.

More recently, the activities of the Dry Season Cropping Committee have become important. Established in 1980 by the MOAC to promote an expansion of dry season cropping the large-scale irrigation projects, the Committee is the only planning body with an overview of the whole project. It meets on a monthly basis and discusses cropping targets and water requirements.

To ensure the necessary coordination of all agencies at the local level, a Provincial Coordinating Committee was established, chaired by the Governor of Khn Kaen Province.

To oversee on-farm land consolidation works, a Central Land Consolidation Office (CLCO) was established in January 1979 which declared the NWPAP under the Land Consolidation Act and was active in the changes in project design.

At the provincial level, project coordination has posed difficulties. Regular manager meetings were recommended between the project managers and project officers from the various agencies, to review progress in project implementation and complaints from farmers.

4. ASSESSMENT OF SYSTEM PERFORMANCE

4.1 Water Distribution

The operation and maintenance (O&M) of the NWPAP was the responsibility of the Nam Pong Operation and Maintenance Office. The office was based on centralized control with a functional division of work. The field work was handled by 2 Water Masters and 8 zonemen, with a supporting staff of gate tenders, canal tender, and labourers. Staffing was, however inadequate to meet the demands of an efficient O&M system.

These difficulties were recognized by RID and proposals were prepared for the establishment of another section for water management and an increase in staff numbers. A reorganization is proposed based on the different zones in the irrigation system and its operational requirements. Most of these staff have been provided, but the reorganization has yet to receive official sanction.

4.2 System Maintenance

The irrigation department will be responsible for the operation and maintenance of the irrigation system down to the farm turnouts, the service roads, and the main and collector drainage system. Below the farmer turnout operation and maintenance will be the responsibility of the farmers, through the formation of water users' associations. RID would promote the establishment of such water users' groups and provide them with technical assistance.

The WUGs will maintain on-farm irrigation facilities such as canals and feeder roads, and collect O&M fees. They will further assure an equitable distribution of water and resolve possible conflicts related to water distribution at on-farm level.

4.3 Irrigation Fees

In several irrigation projects, provisions have already been made to impose and collect an O&M fee after completion of the tertiary system. Furthermore, the Government has agreed to impose charges to recover at least 50 percent of on-farm development costs plus a portion of the main system costs.

Collection of O&M fees has so far not been carried out because of the floods in 1978 and 1980 and the delay in the preparation of guidelines.

4.4 Agricultural Performance

The cropped area, yield and production in the project area between 1974 and 1982 are summarized below.

The dry season cropped area increased from 3 ha in 1976 to 3016 ha in 1981. Severe water restrictions occurred in 1982, but in 1983 there was a dramatic upsurge in dry season cropping to 6760 ha.

Wet season cropping increased from 8501 ha at the beginning of the project to 10 837 ha in 1982/83 as the irrigation systems were rehabilitated and on-farm works completed. As expected, cropping intensities were low in the initial years due to disruption by construction work. A more intensive agricultural extension programme was initiated in 1980 and the cropping intensity improved from 100 to 123 percent in the 1981/82 year. In 1983 a cropping intensity of more than 160 percent was reached. This is near the maximum possible under the present system. Upgrading of the elevated

flume and raising of the Nong Wai Weir will allow additional dry season cropping to a maximum of 80 percent of the area.

Although it was originally envisaged that the dry season cropping pattern would include 500 ha of vegetables and 450 ha of groundnuts, in practice virtually a rice double cropping monoculture has been adopted. This follows a similar pattern to other irrigation systems in Thailand where the low risk and assured markets make rice the most attractive proposition for farmers while they have the opportunity to increase incomes by cropping new areas during the dry season. Once a maximum cropping intensity is reached farmers can be expected to gradually adopt high yield/high value crops in order to further increase their incomes.

Satisfactory increases in paddy yields have been obtained under the project. In 1976 the wet season yield was 2.14 tonnes/ha and this increased to 3.13 t/ha in 1982, a rate of 7.7 percent per year. Dry season paddy yields increased from 2.06 t/ha to 3.31 t/ha over the same period or 10 percent per year.

The major constraint of agricultural production is the high costs of farm inputs relative to the prices received by farmers for their products. Other important constraints are uneven land levelling, the lack of skills to handle new technologies for disease and pest control, and climatic hazards such as floods in 1978 and 1980 and drought in 1982.

A five-year agricultural development programme has been prepared for the 1983-87 period. Emphasis during this period will be on the upgrading of farmer institutions, particularly water users groups (WUG) and the cooperative society, in order that the local community can assume an increased responsibility for their own development effort in future.

ANNEX I

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YOGYAKARTA, INDONESIA
16-22 July 1984

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Mr. R.M. Kosasih
Staff, Directorate for Social and Politics, Ministry of Foreign Affairs

Field Trip:

Ir. Wimson Freddy Purba
Section Head, IGA

Ir. Suseno
Section Head
Subdirectorate O&M
Directorate of Irrigation I, DGWRD

ANNEX II

EXPERT CONSULTATION ON IRRIGATION WATER MANAGEMENT
YOGYAKARTA/BALI, INDONESIA
16-22 July 1984

AGENDA

Sunday 15 July — Arrival of participants

Monday 16 July — Opening Session - Location: Auditorium LPP

Welcome address - Director-General Food Crops, Ministry of Agriculture, Mr. T.B. Suhardi Wiratmadja
- Vice Governor Yogyakarta, Sri Paduka Paku Alam VIII
Opening address - FAO Representative, Dr. D. Bap Reddy
Keynote address - USAID, Mr. Norman Uphoff
Opening address - Jr. Minister for Food Crops, Mr. Wardoyo

Technical Session No. 1
Chairman: Mr. Lockman Soetrisno

1145-1200 Introduction
1200-1245 Presentation Indonesian Case Study I by Mr. Budiman Notoatmodjo
1345-1430 Presentation Indonesian Case Study II by Mr. Suprojo
1430-1600 Discussion groups on case studies
1615-1715 Plenary Session

Tuesday 17 July — Technical Session No. 2
Chairman: Mr. Pieter J. Dieleman

0800-0845 Presentation of Philippine Case Study by Mr. B. Bagadion
0845-0915 Presentation of Sri Lanka Case Study I by Mr. C. Wijayaratna
0915-0945 Presentation of Sri Lanka Case Study II by Mr. N.G.R. de Silva
1000-1130 Discussion Groups
1130-1245 Plenary Session

Technical Session No. 3
Chairman: Mr. Benjamin U. Bagadion

1345-1430 Presentation Chinese Case Study by Mr. Ren Hongzun
1430-1515 Presentation Indian Case Study by Mr. K.K. Singh
1530-1700 Discussion Groups
1700-1800 Plenary Session

Wednesday 18 July — Technical Session No. 4
Chairman: Dr. Mark Svendsen

0800-0900 Main issues identified in discussion groups
Plenary discussion
0900-1030 Discussion groups on specific issues
1045-1145 Plenary Session
1145-1245 Discussion groups on specific issues

Technical Session No. 5
Chairman: Mr. N.G.R. de Silva

1345-1445 Plenary Session
1445-1615 Discussion groups on specific issues
1630-1730 Plenary Session
1930-2130 Drafting Committee

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Thursday 19 July FIELD TRIP

Departure
Tegalweru : Traditional village irrigation: evaluation cooperation of farmers in system operation
Randugowang : Technically improved village irrigation (sederhana); short evaluation and comparison
Kalo Proga Project (Mataram Canal) : Large scale irrigation project with tertiary development
Belimbeng, Dharmatirta, government supported water users' association

Friday 20 July Technical Session No. 6
Chairman: Mr. Pieter J. Dieleman

0800-0815 Presentation preliminary conclusions and recommendations
0815-0930 Plenary Discussions

Closing Session

1000-1030 Presentation summary of conclusions and recommendations by Mr. Budiman
1030-1040 Closing address by USAID, Dr. D. Merrey
1040-1100 Closing by Minister of Public Works

Saturday 21 July FIELD TRIP

Departure
Visit to Subak Pre-Museum and Pacung Babakan Subak
Visit to Subak Grane, Lungsiakan Weir and Ubud Painting Museum (optional)