INFORMATION SUPPORT SYSTEMS FOR FARMER MANAGED IRRIGATION

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Overview of the Workshop

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In many countries in Asia and elsewhere governments are becoming increasingly aware of the importance of sustaining the productivity of farmer managed irrigation systems. Farmer managed irrigation systems often play an important role in the economies and agricultural production in developing countries. Farmer managed irrigation systems (FMIS) are continuing to be developed, largely through local initiative and resource, along river courses and over groundwater aquifers. This is leading to heightened competition for water and rising environmental problems in many areas.

Governments are increasingly concerned with the need to introduce regulatory arrangements for water use at the level of the resource base (river basins, groundwater aquifers and watersheds). It is clear that sustainable use of resources which are primarily locally-managed depends in large part on viable local institutions. In the past government assistance to FMIS have often been attempted without adequate planning and information about highly variable local needs and capacities. Governments are increasingly concerned with the need to improve assistance strategies and rationalize water rights through better information systems about the farmer managed irrigation sector.

Hence, in recent years government agencies, non-government organizations and research institutes have been steadily developing new methods to improve the information base available on FMIS both for external support service providers and even for farmer organizations. Such methods as rapid or participatory rural appraisal, semi-structured interviewing, system walk-throughs and simple mapping techniques have all been applied to collecting concise data on large numbers of irrigation systems. These methods can provide summary information on locations and physio-technical, agricultural, socio-economic, institutional and managerial aspects of all FMIS located along river basins. Questions of data collection, processing, analysis, presentation and utilization were all discussed at the Workshop. Field trips were made to southern Luzon to allow participants the opportunity discuss these issues and methods with farmers, officials and each other while visiting irrigation systems.

The goal of the Asian Regional Workshop on the Inventory of Farmer Managed Irrigation Systems and Management Information Systems was to enhance to sustainable development of farmer managed irrigation through improving information and its use about FMIS. Key objectives of the Workshop were: 1) to facilitate exchange of experiences and ideas between professionals who have been developing or using irrigation resource inventories and management information systems, 2) to provide an opportunity for participants to interact in the field and test some techniques related to irrigation inventories and 3) to produce and share a proceedings document between participants and other interested professionals.

The Workshop was held at the Development Academy of the Philippines in Tagaytay City, Philippines from October 13 to 15, 1992. The Workshop was a mixture of paper presentations, plenary and small group discussions and a field trip. (See Annex 1) Twenty-three participants from eight countries attended the Workshop and exchanged experiences with the use of irrigation resource inventories, irrigation system profiles and their incorporation into management information systems. (See Annex 2)

Workshop discussions were related to seven themes:

1) information needs (including type, levels, quantity, indicators and indicator measurement;

2) sources of information and collection strategy;

3) data processing, analysis and interpretation;

4) data presentation and use (including use by farmer organizations);

5) use of information for monitoring, evaluation and feedback;

6) incorporation of irrigation resource inventories into more general management information systems; and

7) institutionalizing irrigation resource inventories and management information systems.

Participants divided into two smaller discussion groups for part of the Workshop and produced reports summarizing their suggestions about irrigation inventory formats and methods. (See Annex 3)

Seventeen papers were presented at the Workshop. Papers by Bruns, Yoder and Gosain presented conceptual frameworks and methodological issues for irrigation resource inventories and information systems. The rest of the papers reported on experiences with irrigation inventories and information systems in the Philippines, Indonesia, Malaysia, Thailand, Nepal, Bangladesh and Portugal.

The traditional and increasing importance of farmer organizations in handling the management of irrigation systems calls for the development of appropriate information systems designed to fit information requirements of both farmers and support service providers. The many successful examples of traditional FMIS (such as in Bali, northern Luzon, Nepal and northern Thailand) indicate that farmer organizations have been able to devise functional information systems to regulate water and diffuse conflict. The recent trend of transferring irrigation management from agencies to farmers presents new challenges for designing information systems that match both farmer needs and the agency's transformation to more a service provider than a direct manager.

The inventory process and management information systems generally include technical, agricultural, institutional and management performance information for single or multiple irrigation systems located along river courses. Such inventories may be incorporated into planning or decision-support management information systems (MIS) to assess performance problems and differential needs between FMIS for external assistance. As several Workshop participants have pointed out, the inventory method has much potential to meet the information needs of farmer organizations to help establish water rights, settle disputes, support formation of federated river basin farmer organizations and monitor problems along river courses. Resource inventories may also include data above the level of irrigation systems, including river basin and watershed characteristics and environmental conditions. Some information needs are recurring, such as for scheduling planting times, water distribution and monitoring maintenance needs. Some information needs are more singular or ad hoc, such as for planning development of a river basin authority, locating sites for developing new FMIS or for examining water conflicts or problems such as landslides.

Keeping in mind the need for practical information systems to be concise and easy to use, participants identified the most important kinds of data needed for irrigation resource inventories. The most common technical information identified was the location, type, materials and condition of water diversion, conveyance, distribution, and sometimes, measurement structures. This includes how functional the structures are relative to need. Also of potential importance is an assessment of water availability and potential for system expansion. The most common kinds of institutional information identified by participants were water rights and conflicts within and between systems, water allocation and distribution rules and the structure and functioning of farmer organizations. Key agricultural information included cropping patterns and intensities, timing of planting and harvest and potential for agricultural intensification. Key management performance information identified were equity of water distribution, functioning of operations and maintenance tasks, resource mobilization by farmers and existence of environmental problems.

Distributed Information Systems for Farmer-Managed Irrigation

Bryan Bruns

INTRODUCTION

Management information systems should enable managers to make better decisions. If farmers operate and maintain irrigation systems, then inventories and other information systems should serve them, as well as irrigation agency staff and others who provide services for farmer managed irrigation. This paper explores some conceptual principles for developing efficient information systems to support farmer management of irrigation.

Information system structures should recognize that knowledge and decisions are widely distributed. Design should work back from decisions to the minimum information and analysis needed to support decisions. A modular architecture coordinated by common standards can allow information systems to evolve efficiently. Walk-throughs, water user association self-assessment and techniques for participatory rapid appraisal can help support local collection and analysis of information as part of information systems designed to support distributed management of FMIS.

Farmers and agencies already gather and analyze much information regarding farmer managed irrigation systems (FMIS). However, this information collection is often informal or embedded in other activities. The question is whether more systematic and formal information systems may improve the performance of FMIS.

Farmers may be unaware of how their irrigation activities affect others within a catchment basin. They may not know how well their irrigation management compares with that in other systems and so lack a basis for assessing what opportunities may exist for improving performance. Agencies often have only very incomplete information about how many FMIS exist and how much area FMIS irrigate. Inventories and other research on FMIS have shown in country after country that the areas irrigated by FMIS are far larger than originally shown in official records. Lack of information about the extent of FMIS perpetuates policies that channel most agency resources into assisting larger government managed irrigation systems. Even when governments try to assist smaller systems, agencies may direct assistance to those systems with which they are familiar, while neglecting other needier systems. However, more information is not necessarily better, as a few examples may illustrate.

1) A questionnaire on village agricultural water resources in Thailand grew to improbable length. It was combined with an even longer national survey of other village level information, and (in part courtesy of some short-sighted internal agency politics) ended up producing excessive information of little relevance and dubious quality.

2) Socio-technical profiles of small irrigation systems in Indonesia and Thailand were frequently ignored in later stages of project implementation even though they contained valuable information about local management practices and problems.

3) A carefully prototyped system for assessing village water supply needs in Thailand drew praise from government officials, but little usage, probably because provincial and district officials had little power to respond to the needs shown by the system.

4) In one Indonesian province, years of work were spent developing methods for agency staff to conduct inventories of FMIS. When a senior provincial irrigation official was asked what he saw as the most important benefit, he replied that inventories would identify sites where separate systems could be combined to use a single dam. He focused on potential technical efficiencies, with little concern for the social complexities of integrating previously independent organizations.

While these happen to be cases with which the author has some familiarity, they seem to be part of a more general pattern of sometimes disappointing and potentially counterproductive results from attempts to gather systematic information about locally-managed water resources. Thus, it is crucial that the design of information systems emphasize efficiency and usefulness.

INFORMATION OVERLOAD

Government policies in many countries are giving increasing recognition and support for farmer managed irrigation systems. This requires better information about FMIS. At the same time technological changes are reducing the costs of managing information.

Photocopiers have become widely available even in small towns in much of Southeast Asia, making it cheap and easy to reproduce information. Computer spreadsheets provide a convenient tool to keep track of lists and handle simple analysis. Database programs offer even more ability to manage large amounts of data on personal computers. Information technologies will continue to deliver increasingly cheaper and more powerful ways to store, manipulate and communicate information. The convergence of policy shifts to support small scale irrigation with lower costs for storing and manipulating information should create opportunities for using information systems to improve FMIS.

However, regardless of whether information systems use paper records or computer databases, it is much easier to design forms and collect data than to set up systems that will be useful for improving decisions about FMIS. Information systems that start by simply assuming that more information must be better may well succeed in generating plenty of paper, but have little further impact. If data is hard to use, old or inaccurate, then it is unlikely that farmers or irrigation officials will pay attention to it.

Information overload may be a greater problem than information scarcity. Visits to agency offices tend to show not people desperately waiting for more data but rather people sitting at desks buried in paper. They may not have the information they need but there is no shortage of data. Indeed, the abundance of data tends to bury whatever relevant information does exist. Anything produced by an inventory will have to compete to stand out in this swamp of existing documents.

Often those designing information systems, and those who collect the data, show little explicit concern with involving farmers in management decisions. Farmers are treated as the objects of data collection, rather than as managers who can be users of the information system. Usually farmers never see what happens to the information after it is collected.

Current institutional structures for financing irrigation construction and management create counterproductive incentives, encouraging excessive construction and bureaucratic expansion (Repetto 1986). By themselves information systems cannot overcome incentives created by overly centralized bureaucratic structures and subsidy oriented policies. However, better information systems may be one part of reforms to improve institutions for irrigation management.

The development of information systems for FMIS is not a neutral process. Such systems can either enhance or undermine farmer management. If information about physical structures appears without the context of irrigators' organizations and water rights, then information systems may encourage ill-informed and unproductive government intervention. Many past interventions in FMIS, though usually well intended, have created unnecessary disruption of local institutions for irrigation management.

Unless carefully designed, information systems may act to undermine local autonomy and shift decisions about irrigation management away from farmers. If information systems are to avoid such contrary consequences, they need to be part of approaches which respect and enhance local competence in irrigation management.

DISTRIBUTED INTELLIGENCE

Often the design of information systems, consciously or unconsciously, assumes that the system serves a single central "*decision-maker*". This is particularly a problem given the diversity of FMIS and the importance of location specific information about slopes, soils, crops and village society. Most detailed knowledge is available locally. Farmers usually have strong incentives to manage FMIS well.

Rather than assuming one or a few central decision-makers it is more accurate to assume that knowledge and decisions relevant to management are widely distributed. Many different people make different kinds of decisions. Most of the decisions rely on current formal and informal informations systems. Some may benefit from more formal and systematic information systems. The goal of information systems should be to enhance existing systems of distributed information, not to concentrate information and decisions in one place.

Most planning systems, in irrigation as in other sectors, work from the top down, driven more by the supply of resources from centrally controlled programs than local demand for government services. Even if structures exist for bottom up planning they are rarely accompanied by decentralization of authority over budgets. Thailand has an elaborate bottom up planning process for water resources development. However, requirements that projects be centrally screened congest the system. Most funding depends on agency budgets made up with little or no reference to locally initiated requests. The exceptions to this have been programs to provide funds directly to tambon (sub district) councils, which they can use for rural infrastructure works selected by the council. However, district officials still tend to intervene heavily, shaping the selection of projects to serve goals of the Ministry of Interior, with limited concern for local conditions and the autonomy of local decisions. Processes such as these limit the roles of farmers and local leaders in making decisions concerning government intervention in FMIS.

However, farmers and local leaders have major roles in the self-management (Ostrom 1992) of individual WUA and are often active in intersystem management. Developers of information systems can recognize these roles and use information system development as part of strengthening procedures for more open, public decisions-making in irrigation development. Such measures include greater recognition and legal support for the role of local self-management, deconcentration of agency activities to levels closer to farmers, devolution to local authorities with tax raising powers (including WUA) and methods for enabling farmers to collectively borrow funds for irrigation development.

Information systems to support distributed decisions need to serve a diverse set of users, as figure 1 shows. These include individual farmers and water user association leaders within an FMIS and may also include leaders of a WUA federation. Agency users include field staff working directly with farmers as well as managers at higher levels, particularly those making decisions about allocation of government resources. Special catchment authorities or other bodies may exist or be created to deal with both FMIS and agency managed systems relying on the same water resources.

Figure 1. Potential MIS users

Farmer
WUA leaders
Irrigation agency field staff
Irrigation agency and other government offices
Policy-makers and funding agencies

Decision-makers at different levels have different needs regarding the accuracy, timing and level of detail or summarization of information. The design of information systems needs to take these into account rather than just assuming that one uniform database and level of reporting can serve all users. One of the key potentials of computers is the ability to customize reports according to needs. More or less detail can be included. Graphics make information much easier to understand.

Designing an information system for distributed use also means that is operation will not be dependent on only a few individuals. It requires developing simple procedures for routine use, not just for the needs of a specialized project unit. This increases the chances that the information system will outlive the end of a specific project.

Assuming distributed intelligence leads to a different view of coordination. Some coordination may occur through joint meetings or decisions by an executive. However, much more common are patterns of mutual adjustment, as people arrange their activities based on what they know about the policies and practices of others (Lindblom 1977). Information systems can help make people better aware of what others are doing, facilitating decentralized patterns of coordination through mutual adjustment. Coordination can occur on a peer basis without being imposed from above or explicitly negotiated. Only when these methods for coordinating water usage along a stream become necessary.

WORKING BACKWARDS

The goal of information systems is not to collect and store information. The goal is to deliver information which will be useful. Too often the information collected is inaccurate, irrelevant or outdated. To make information systems useful, their design has to start from the ways in which people will use them to make decisions, and work back from there to determine the information to collect.

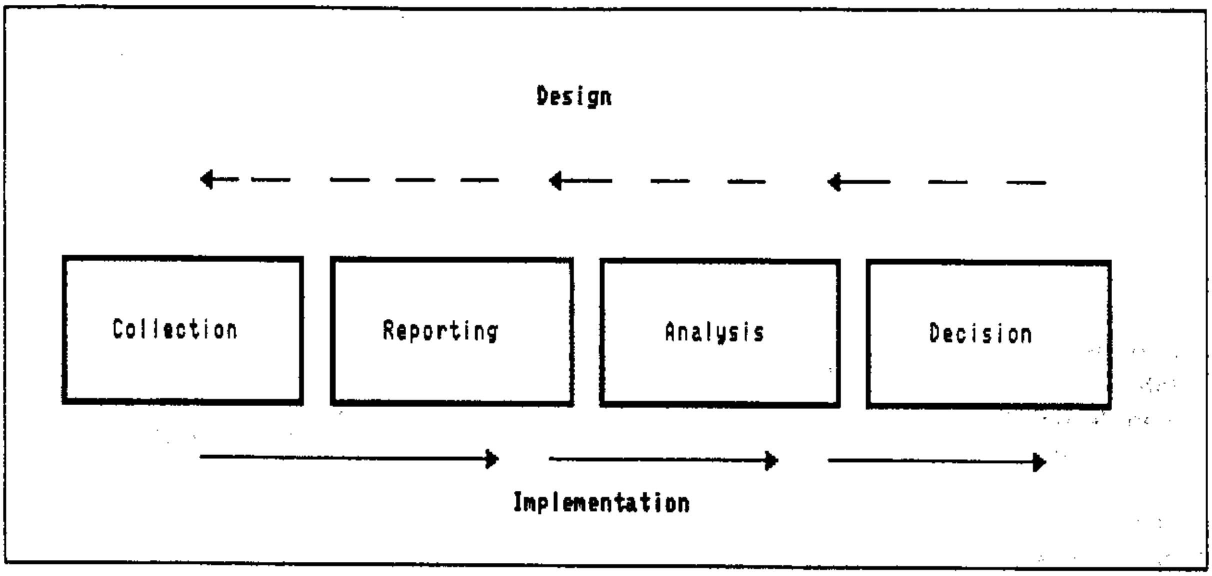
The users of information must be identified in the process of designing and refining an information system. This also helps build a broad based constituency for the information system, rather than depending on a single high level sponsor. One of the key reasons for the failure of monitoring systems is an overemphasis on providing information that might be relevant for senior policy makers, while neglecting to provide useful information for those involved in implementation (Casley and Kumar 1987).

One tendency in developing an inventory or other information system is to start by thinking about what information to collect, without paying sufficient attention to how to use the information. This tends to result in long forms containing large amounts of information of dubious quality.

Rather than assuming that systematic information is needed about everything, it is much more efficient to assume that information systems will handle most information and only specific types of data need to be collected systematically. The goal is not to collect as much information as possible but instead to optimize collection of information, gathering the minimum necessary to make decisions, taking into account the cost of collecting the information and the importance of the decisions to which the information contributes.

As in most planning, the best approach to designing an information system for FMIS is to start at the end and work back by examining what is required to reach that point. Planning should work back from the decisions to be made, to the analysis needed to make decision, the information needed for analysis and the sources from which the information can be collected, as figure 2 shows.

Figure 2. Information system design should work from decisions to be made



A major task to which inventories can contribute is coordination of water use during periods of scarcity. It is hard to facilitate equitable and efficient allocation of water among systems, without knowledge about who is using how much water and the basis for their claims to water. Inventories can give a comprehensive picture. However, in thinking about information systems for intersystem water allocation it should be remembered that government officials are not the only ones who can make decisions. A federation or other forum bringing together representatives of irrigation systems may also use the information.

The needs for information to manage basin level conflicts define one set of data for an information system. Maps, schematic diagrams, water balance studies and other techniques may help display and analyze information. Visits by farmers to other systems, video recordings and other methods may be equally useful in improving shared understanding about the severity and consequences of water shortage. Thus a formal information system is at best a tool which can aid the search for ways to resolve intersystem conflicts.

Water scarcity is likely the most common problem which creates a need for information about diversions by all the irrigation systems in a catchment basin. However, there may be problems with water quality, due to pollution from pesticides, mining or other sources. Deforestation and other changes in land use may affect stream flow patterns and silt levels and require an overview of conditions.

Technical and financial assistance is another major task for government support of FMIS. In theory an inventory can gather information about needs. A management information system could use this information to help prioritize needs for assistance. However, such an approach could also perpetuate top-down approaches to planning which ignore local priorities and leave little room for local initiative.

Much research suggests that farmers overall do a competent job of managing FMIS. This is usually the most appropriate assumption for designing information systems and other policies and procedures regarding FMIS. The need is not for a uniform program of intervention but rather government intervention which suits the diversity of local conditions.

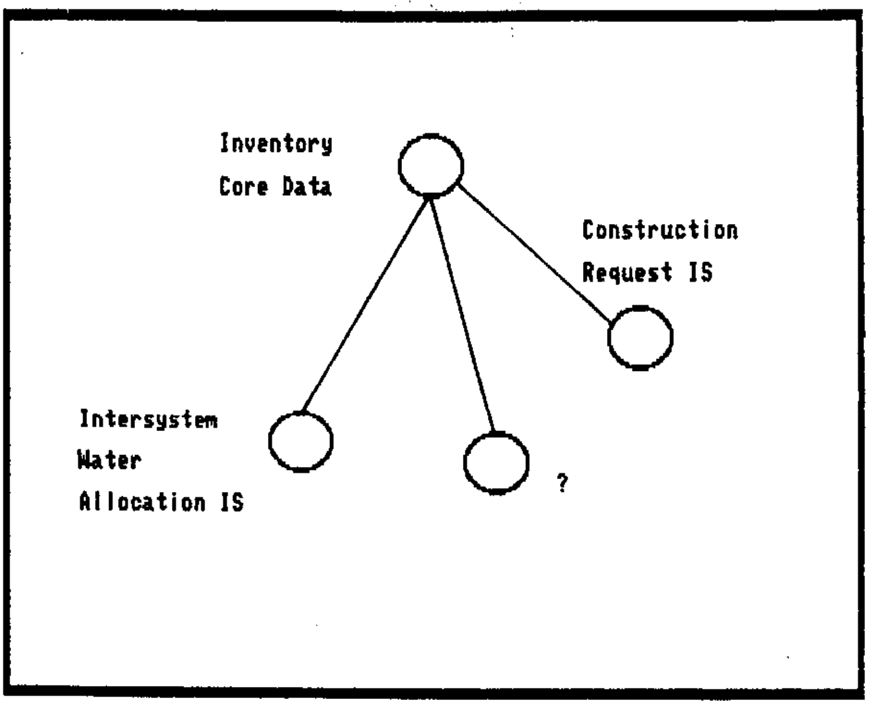
Assistance is likely to be more appropriate if based on responses to local requests. Those local requests may in turn be responses to announcements about the availability of government assistance. An information system can make it easier to keep track of requests. Comparative information from inventories and other sources provides one basis for assessing requests.

If authority over budget is still centralized then it is probably premature to invest much effort in improving the information systems for officials who are unable or unprepared to make decisions. Instead, the first priority would be to decentralize management and then to provide information systems to support decentralized decisions.

In practice each program has specialized needs for new information tied to the goals, level of funding, requirements for local cost-sharing and other program characteristics. Even if a "comprehensive" inventory has been carried out, new programs will probably require collecting additional information. An earlier inventory or information system may provide a useful starting point but is unlikely to be able to provide all the information needed for planning a new program.

MODULES

Figure 3. Architecture of a modular FMIS information system



FMIS are diverse. They include gravity and lift irrigation. Sizes range from thousands of hectares to less than ten hectares. Water may be abundant or scarce. Management tasks differ. Rather than trying to collect a single uniform set of information on all systems, it will be more efficient to have standards for adding specialized subsets of information according to need. These can contribute to a cumulative process of building a public database of information about FMIS.

The architecture of such an information system would consist of a small common core of information supplemented by modules which contain information about specialized aspects of FMIS. The core module would consist of perhaps less than a dozen items of information, mainly concerning location. The most basic element is an identifying name or code number for individual irrigation systems. This identifying information can then be supplemented by more specialized sets of information according to need.

Collecting this core data will help address the primary issue of showing the extent of FMIS. Keeping the amount of data collected small can make an inventory faster and more affordable. Rapid appraisal and other diagnostic studies will probably be more useful than a comprehensive inventory for generating information about types of needs.

The architecture ot a modular approach to information about FMIS would be a relational database with linked subsets of information, rather than a single flat uniform database. Information needs to be kept for different management levels, which may range from individual farmers to the national level and beyond. Different sites can keep various subsets of information, and exchange or update data using standard procedures.

A modular approach provides a way to incorporate existing information from various sources rather than having to start with a massive data collection exercise. This should be much cheaper and more practical, allowing an evolutionary, incremental approach to strengthening existing information systems.

Supplementary information could be gathered in catchments experiencing water shortages. Such a selective, modular approach to building an information system would concentrate on basins with problems, rather than spending much effort to collect information on areas where water demand is less intensive and there is little need for management changes.

A WUA federation or other body can plan and implement collection of information needed to improve water management. In some basins in Northern Thailand, farmers have taken the lead in inventorying, trying to deal with conflicts concerning dry season water use, deforestation and pesticide pollution of water supplies (Uraivan Tan Kim Yong, personal communication).

Requests for assistance can be a source of information for expanding databases on FMIS. The WUA making a request provides information than can be entered into a database. Irrigation field staff who visit the system to assess the request can help check the accuracy of this information and may also be able to contribute more information about structures and other technical data.

Requests for construction of permanent dams can be linked to information about water use downstream. To accomplish this, an information system would need a way to show the relative position of a system within a catchment.

An information system can be one tool in a planning system. If it includes information about water rights it becomes more useful, but still does not eliminate the need for procedures by which those who may be affected by new construction can be informed about the proposed changes upstream and receive an opportunity to have their views considered.

Irrigation management transfer or "turnover" is another example of a program with specialized information needs. Where farmers are taking on new responsibilities, there may be a need for specialized monitoring of how performance changes as management shifts. This may draw on WUA self-assessment as well as observations of agency staff. Thus a module for monitoring irrigation management transfer would emphasize indicators sensitive to changes from agency to farmer management.

There may be other specialized modules of information, for example in areas where groundwater extraction is intensive enough to lower water tables and create conflicts. The approach would be one of an evolving information system rather than a single massive census. Information from different sources would accumulate in linked databases at different organizational levels. Information would then be presented according to the needs of different users.

The result of a modular approach to collecting and storing information about FMIS will be a set of databases, with a small common core and specialized subsets of additional data accumulated according to need. This fits fairly closely with current agency practices of collecting information periodically for particular projects. The difference is that if there is a shared architecture then information from different projects can be saved and re-used. Rather than starting from zero for each new activity, time can be spent instead on improving data quality.

With a modular approach the most important product of information system development is not a single massive central database. Instead the key activity is to establish a set of standards for defining and structuring data. These standards can make it possible to efficiently gather and share information among those involved in decisions about farmer managed irrigation.

METHODS

Several specific methods can enable greater involvement of farmers in collecting and analyzing information. The most familiar of these is the walk-through, already commonly used to enable designers and farmers to look at irrigation systems in the field and discuss potential improvements, including canal routing, design of structures and other specific problems.

Methods are also being developed to assist farmers in self-assessment of their activities in irrigation management (Lauraya and others 1991; Uphoff 1988). These usually focus on seasonal meetings in which WUA leaders and members review irrigation management in the last season and plan for the future. A list of topics may help structure discussion. Based on this meeting, farmers may report their needs for services to the agency. Information from forms recording FMIS requests for help can then be included as part of an agency managed information system.

Rapid rural appraisal has demonstrated that farmers can interpret maps and air photos and gain a different perspective on local resource management (Khon Kaen University 1987). More recently, efforts in India and Kenya have emphasized participatory rapid appraisal (Mascarenhas and others 1991). In PRA villagers can inventory local resources and identify resource management problems. Simple tools such as stones and sticks can display cropping calendars and other information. On the basis of their own efforts, supplemented by outside resource persons, local people can analyze problems and make plans for improving the management of local resources.

Methods for participatory rapid appraisal support learning by farmers about resource management. They could be easily adapted for irrigation information systems, or more accurately they can be part of a process of participatory development which information systems can support. They would make the collection of information a more public process and one which does more to support local management capacity. They assume that most problems should be managed locally, rather than extracting local information and then processing it somewhere else. Outside assistance is requested only for specific problems, where local capacity is lacking.

As mentioned earlier, WUA themselves can conduct inventories. Maps and scale models are valuable tools for displaying the results of inventories in ways that encourage public discussion. Overlays on maps help compare different types of information. Most of these methods can be carried out using inexpensive, easily available materials.

As the volume of information increases, computers become more useful for storing and reporting data. As computers continue to become cheaper, more powerful and more ubiquitous then computer based methods will play an increasing role even at the level of individual FMIS. The shrinking size and cost of computers make it almost certain that not too long from now they will be as widely available as electronic calculators are now. The question then is not one of availability but what tasks can be done better with the assistance of computers.

Geographic information systems (GIS) may help organize and display information about FMIS. To link system level information with GIS, latitude and longitude will need to be recorded, either from maps or using global positioning satellite equipment. GIS can help integrate information from other sources to provide a broader picture of such factors as soil types, land use, cropping patterns and other factors. GIS information, particularly that based on remote sensing, may provide information to help check the accuracy of information from field inventories and other sources, and vice versa. However, the costs and skills required to develop a GIS need to be carefully considered in comparison with the potential benefits.

Remote sensing information from satellites is becoming increasingly available, though still relatively expensive and lacking detail for units the size of small FMIS. Increasing awareness of the easy international availability of satellite imagery should encourage governments to allow wider access of their own citizens to maps and remote sensing data.

Where water use in a catchment basin has been inventoried, simulation models may be used to help analyze the situation. Models are likely to be limited by the accuracy of information about soils, cropping patterns, return flows and other factors. Thus models alone will be insufficient to make decisions. Nevertheless, they provide another tool for integrating information from various sources and exploring relationships. The Bali model (Kremer 1991) is an example of an attempt to show the logic of existing local institutions for managing water. An easily understood graphical interface makes the results of the model visible to agency staff and farmers. They can explore the implications of management changes. With time, such models will become increasingly common. The need will be to encourage development of models in ways that support local decision-making in FMIS and not just exporting information and decisions to distant provincial or capital cities.

CONCLUSIONS

The overload of irrelevant, inaccurate and obsolete information is as much a problem as information scarcity. Information systems can support distributed decision-making at many levels of management, including leaders of individual WUA and WUA federations coordinating water use. Design should work back from the problems which information system can help solve. Information systems can start from a minimal core of information, and grow through addition of specialized modules which collect information relevant to particular tasks such as basin management and planning of government responses to requests for technical assistance.

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Data Management, Analysis and Report Writing for a Field Based Irrigation Resource Inventory

Robert Yoder

INTRODUCTION

This paper outlines several objectives and potential uses for an irrigation resource inventory. It uses an example from the country of Nepal to focus on the development of inventory methods that would meet differing needs at several levels within irrigation, planning and policy agencies of the government. While the primary objective is to identify farmer-managed irrigation systems and specific information about each, it is proposed that an irrigation resource inventory go beyond that. It is suggested that the inventory process be used to tap farmer knowledge and experience of their local environment to identify opportunities for augmenting the irrigation supply to their existing systems and to get farmer suggestions concerning constructing entirely new systems.

INVENTORY PURPOSE AND USE

Information about irrigated agriculture at the local level, where farmer-managed irrigation systems are of critical importance, is lacking in many countries. Land capability maps, topographic maps, cadastral maps and aerial photos exist but do not explicitly identify farmer-managed irrigation systems because their small size farmer canals do not show up on most maps and aerial photos. Though land use maps indicate irrigated area, the fact that there are multiple, often interrelated but distinctly different systems serving the area is missing. Cadastral maps are used to identify land ownership and have sufficient detail to show irrigated area but information about irrigation was seldom explicitly collected and again there is no differentiation among systems in an irrigated area.

While farmers have built and operated irrigation systems for many generations, the modern development era of the past five decades has tended to overlook their accomplishments. New systems are sometimes proposed and have frequently been built that overlay existing ones with the expectation that they will be technically more efficient. Some are successful but many are plagued with management problems. Maintenance budgets cannot be met and the rules essential for operation -- allocating of the irrigation supply among users, irrigation distribution procedures, resource mobilization and management of conflicts -- have lost their local under pinnings.

In the past decade the failure of expected output from investment in construction of new systems together with improved information about the extent of farmer-managed irrigation has caused a shift in irrigation investment emphasis. Increasingly programs are designed to provide assistance for improving and expanding farmer systems. Though farmer systems are now recognized as an important resource, there is not sufficient information available about individual systems to identify the type of site specific support that would be most useful. In a mountainous area like the Himalayan foothills in Nepal, for example, it is not uncommon to have several hundred irrigation systems in one watershed. Though it is known that there are many systems, without identification of each system and its unique problems it is not possible to identify priorities for the scarce resources available for assisting these systems.

In countries where support services are being set up or assistance programs established for farmer-managed irrigation systems, the primary purpose for an irrigation resource inventory is to prepare accessible information about the current status of each system. Collecting information for such an inventory must be based on field visits to the systems and offers an unique opportunity to systematically tap the farmers' information on further irrigation development potential in their micro areas.

The use of an irrigation resource inventory can be outlined as follows:

Policy Needs

- To provide an accessible, enduring record of all irrigation infrastructure in a watershed in a format that can be sorted at will for different purposes and needs and that can be updated easily.

- To supply input for preparing an overall irrigation development strategy that does not overlook existing resources.

- To use for setting priorities for investment in the irrigation subsector that identifies cost-effective opportunities for increasing food production (for example, the priority might be to first assist systems with available land and water resources for expansion of irrigation to new area in order to benefit families that may not have irrigated land).

Project Implementation Needs

- To determine water allocation among systems in a watershed.

- To select among candidates systems for assistance in order to match policy strategy (for example, expansion of irrigation to unirrigated land, intensification of cropping, or reliability of irrigation service, etc.)

- To provide first level identification of system deficiency (physical deficiency, management ability, labor and other resource mobilization, etc.)

- To provide first level identification of system institutions and experience which can be used to expand, intensify and improve irrigated agriculture or that need to be modified if expansion is desired.

- To establish implementation priority that allows effective supervision.

Research Needs

- To identify systems to use for demonstrating good irrigation management practices that can be used as sites for farmer-to-farmer training.
- To identify and classify problems that require research attention.

PROBLEMS

An irrigation resource inventory will only be useful if the field data collection is done with sufficient accuracy that analysis will yield the desired results (garbage in/garbage out). There are many pitfalls in accomplishing this. Field data collection will be hard physical work that is nearly impossible to supervise. It will be costly to train teams and support them in the field. Data handling will be a mammoth task which will require continued support.

In many ways this is analogous to building and operating a public library. It sounds like a good idea, one can raise money to initiate it, but funding to continue maintenance and effective operation depends upon the public's perceived value of the facility. Without proper initial cataloguing and continual correct shelving of books the library becomes useless. Over time as new additions are not entered, the system becomes dated and holdings inaccessible. If an irrigation resource inventory collects data that is not entered by a systematic procedure and properly maintained and updated, it will also become useless.

An inventory is an ideal application for a computerized database. Information management and presentation would be enhanced by use of a geographical information system (GIS). Initial capital costs for this are reasonable. However, continued operation and maintenance of the database (and the associated software and hardware particularly for GIS) is dependent upon trained operators. Training must continue so that the turnover of staff can be accommodated.

ALTERNATIVES

There appear to be formidable problems in making and maintaining an effective irrigation resource inventory. It is an exciting idea with a lot of appeal that can easily bog down when the initial support is withdrawn. However, I do not see any viable alternatives for achieving the things listed above without collecting information in the field. Presently most of the work done in collecting information on a project basis gets lost or becomes inaccessible when projects terminate.

Information about existing irrigation infrastructure in a country could be handles in the same way as land ownership. While incentive for maintaining land title records are multiple (taxation and ownership to name two) the returns to an irrigation inventory are much more indirect (in this sense census may be a better analogy than land records). The choice is to whether to muddle along as at present or to do serious, systematic and expensive work to improve policy and management decisions. In the long-run it needs to be determined which will cost the most.

IMPLEMENTATION

The implementation procedure proposed here is based on experience in Nepal. It is assumed that each stream and river has multiple diversions built by farmers. It is also assumed that while some systems have received prior assistance from a government agency, many have never been visited and are not on any agency list of existing systems. Finally, systems will only be visited one time since access requires extended walking.

The approach for collecting field information proposed here is to prepare a detailed questionnaire to be used by a team that interviews farmers in each system. The questions should be based on the experience and information available from past research on farmer-managed systems. If little information is available, a series of rapid appraisal studies should be used to generate the first questionnaire. The reason for moving away from open-ended questioning so useful in a research setting to specific questions developed from research results is to allow numerical, yes/no, or coded answers that can be sorted by computer. While narrative descriptions may be needed, it will be kept to a minimum. This can be done by revising the question list as necessary. Narrative description is impossible to sort and classify effectively in a computerized database.

In the field, the team will meet with farmers and walk along the canal from the diversion through the command area. In addition to the information on the questionnaire, the team will need to make a sketch of the system layout and command area. This must be referenced on the best available topographic map and aerial photo. For larger systems, area can be estimated from the map or photo for comparison with farmer reports of command area size and area for irrigation expansion.

Data Collection

Coded forms need to be developed to allow entry of field information on the form in a format that can be directly keyed into a computer database without recording. This requires several iterations of testing and modification. Criteria are needed for the field team to use in determining the type of existing systems and area to exclude from the data base. For example, in many small basins there are springs or systems in valley bottoms that allow individual or small groups of farmers to irrigate without much effort and which have no potential for further development. These could be marked on the map or aerial photo but the normal question routine may not be followed depending on the selection criteria. Estimation of area irrigated and number of farmers served should be noted even for systems where formal interviews are not done, to allow full and systematic coverage.

After development and completion of testing of the field data techniques, field enumerators need to be trained. In the training process undoubtedly additional refinement of techniques, will be necessary.

Development of Data Handling

A computerized database system should be established to manage the field data. The database software chosen must be evaluated carefully to assure that analysis and reporting capabilities are in line with desired results. If possible the software should be compatible with statistical and GIS packages. Development of the data base requires careful conceptualization of the desired output -- types of queries that will be done and reports to be generated -- in order to match input and file management options.

It will be important to establish a data entry procedure that matches the coded questionnaire. It would be useful if data entry could be done on a laptop computer in the field. Capacity to print a simple report in the field would make verification by the field team easier and allow immediate correction or addition of missing data. It would also allow a copy of the data to be left with the farmers as a record of what they have helped assemble and for them to use in preparation of requests for assistance. Data analysis, sorting and report generation will not be necessary in the field.

Data Analysis

A number of criteria or conditions for sorting and ranking systems are suggestions below. Others needs to be added as experience is gained with the field situation, data handling and analysis options, and procedures and needs.

Water Resource Criteria. 1) Extent to which water is available in the source for system expansion in each cropping season[1] in an existing system; 2) Possibility for augmentation of the water supply from a new source to an existing system; and 3) Underutilized water resource available for developing area not presently irrigated.

Land Resource Criteria. 1) Land area irrigated in one crop season but is fallow in other each year, i.e., the potential for increasing the cropping intensity; and 2) Cultivated or cultivable land area not presently irrigated that lies in the hydraulic command of an irrigation water source.

Institutional/ Participation Criteria. 1) Water rights among systems diverting water from a given stream, i.e. will there be conflict if more water is diverted by a particular system; 2) Water rights (irrigation allocation) within an existing system that determines water property rights and potential for system expansion. The question or issue here is whether the present irrigation users have a mechanism or are willing to create a method for adding additional water users to their system and give them clearly identified rights and responsibilities for being members and using water from the system; and 3) Extent to which lack of organization limits farmers' ability to improve the system on their own.

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1 In some areas, at high altitudes for example, only one crop can be grown each year because of temperature factors. In other areas two crops can be grown and in others crops can be grown all year which, depending upon the community, often translates into three cereal crops each year. The cropping season refers to the duration of one particular crop in a specific location. Thus, in an area where crops can be grown all year and the local practice is (or could be) to grow three crops each year there would be three cropping seasons. Water availability relative to land resources and irrigation practices such as water rights, might be different in each cropping season.

Physical System Criteria. 1) Extent to which physical system (the building structures would rectify) problems limit available water delivery and constrain expansion of irrigated area or intensification of cropping pattern; and 2) Degree to which physical system maintenance costs limit expansion of irrigated area or crop intensification[2] or threaten sustainability of the system.

Agricultural/ Production Criteria. 1) Extent to which crop selection could be used to manage a scarce water resource; and 2) Degree of subsistence or market orientation of the existing irrigation users.

Output Requirements

A multitude of possibilities exist for analysis and report generation. The two main levels of interest are at the local or implementation agency level and the other at the central or planning agency level. The needs of the two are somewhat different.

Local Level. The objective at the local level could be to sort and rank systems by degree of potential for increasing food production if given assistance. Such a ranking needs to consider secondary criteria, such as willingness to allow new irrigators to gain water rights, likely conflict over water among systems, etc., for establishing the priority for giving assistance to systems. This list can then be used to select priority systems for assistance. It allows grouping of systems for assistance to enable intensive supervision of the inputs supplied.

The database can also be used to record assistance and enable rapid access to the status of projects underway and completed, provided such information is collected and entered regularly.

Central Level. At the central level the database information will allow compilation of detailed statistics on area irrigated and the potential for expansion of irrigated area in different cropping seasons. This will enable planning or investment for assistance.

Report Generation

The nature and structure of the database will depend on the type of analysis and reports that are needed. A sample profile report is given below. Detailed reports need to be catalogued for easy reference. Identification of several possible sorting criteria permits preparation of lists of systems that fall into different pertinent categories to consider for assistance (system profile report notes). Flexibility in viewing report information before printing will be important.

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2 If the cropping pattern is one crop per year for a given field in an environment where two or three would be possible, intensification of the cropping pattern means adding additional crops per year to the field.

Documentation

To enable others to understand the rationale and strategy behind the approach used in the questionnaire and software development, there should be full documentation. This should include changes made in the framework after conceptualization. This will facilitate reporting the cost of development and show the evolution of thinking as new information becomes available.

The final step in development of data management will be preparation of an operational manual. The purpose of the manual will be both as a reference and to facilitate training the persons that will need to implement and access the system when it is introduced.

REPORT SCENARIOS

SYSTEM PROFILE

SYSTEM LISTING

By Panchayat and Ward

By Watershed

SYSTEM RANKING

By Irrigable Area Expansion Potential

By Crop Intensification Potential

By Potential for Increased Food Production

By Maintenance Reduction Potential

IRRIGATED AREA AND PRODUCTION ESTIMATES

System Profile Report Notes

1. Table 1 is a prototype of a System Profile Report which could be generated from a database with data supplied from the accompanying questionnaire. A great deal of effort went to making it all fit on one page. The Dhading Development Project in Nepal has compiled an inventory of all existing systems in Dhading District. They found about 3000 systems in one district. A one page summary as suggested by this proposed format would still require 3000 pages. Just a one line listing would require approximately 3000/60 lines per page = 50 pages.

2. "Present" and "potential" area irrigated by each crop is an important way to assess potential benefits from future assistance. "Present" refers to the existing practice and "potential" to the expected level if assistance were given. The potential level would consider both land and water resource availability including the possibility of augmenting the water source if feasible.

3. Water availability assessment indicator value categories are:

   - A abundant compared to need
   - C constrained compared to need (this could be either due to physical or management problems)
   - L limited supply even if managed well

4. Water distribution: R = rotation, C = continuous

Management Information System for Farmer-managed Irrigation Systems

A.K. Gosain [3]

INTRODUCTION

A Management Information System (MIS) is a concept which draws its strength from the computational power of the computers and the present day information technology. Such a system can help in an improved understanding and efficient management of the system for which it is developed. Basic concepts of MIS and the major steps involved in its development have been discussed. A MIS has been conceived which can help the farmers in effective management of Farmer-Managed Irrigation Systems (FMIS). An initial prototype has been formulated to demonstrate the usefulness of such a system in some of the activities pertaining to operation of FMIS.

With the ever increasing population in the third world countries it is becoming more and more difficult to cope up with the corresponding increase in crop production demand. Researchers all over the world are busy in finding ways and means by which crop production can be increased. Only those options which are socially acceptable as well as feasible should be selected.

One such option to increase the productivity is through proper management of irrigation water. In the past, emphasis has been given to the creation of irrigation potential but few gave much attention to the effectiveness of the created potential. Many irrigation projects have been running at very low efficiencies. This is true for both irrigation systems managed by the government agencies as well as farmer-managed irrigation systems (FMIS). Invariably the most common culprit for such low performance of the irrigation systems is the poor management of these systems.

Therefore, it has become essential to adopt an appropriate irrigation management problem-solving approach. It has also been recognized that new issues and trends can best be addressed by crossing conventional boundaries between research disciplines and levels of technology (IIMI 1989). The revolution in computer technology and its amalgamation with information technology has brought about many new concepts which can be exploited for management problem-solving. Moreover, the ever-increasing power and general decrease in the cost of microcomputers has made them affordable and cost-effective.

Management Information Systems (MIS) are one such concept which is being exploited in various disciplines all over the world and can play a major role in helping the farmers in effective management of FMIS.

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CONCEPT OF MIS

An MIS has been defined (David & Olson 1985) as an integrated user-machine system for providing information to support management, analysis, operations and decision making functions. The system utilizes computer hardware and software; manual procedures, models for planning, analysis, operations and decision making; and a database. An MIS for irrigation departments of India has been developed (WAPCOS/LBII 1989).

The term user-machine needs some elaboration for clarity of the definition. Although, a MIS can exist without computers, it is the power of computers which makes MIS feasible. Therefore, it is improper to pose the question as to whether to have a computer based MIS. A more appropriate question would be what should be the extent of computerization. The user and the computer (machine) form a combined system through interaction with each other.

The MIS is usually composed of individual applications which are integrated together. The individual applications within MIS are developed for and by diverse sets of users. Absence of an integration process may cause inconsistency and incompatibility. Integration is also essential if a common database is to be used. The integration of diverse information system applications is accomplished through envisaging an overall MIS plan. Even though application systems are implemented one at a time their design can be guided by an overall plan which determines how they fit in with other functions.

In other words we can say that MIS is a planned federation of small systems. In order to ensure that these diverse applications can share data, satisfy defined requirements and can be shared by multiple users, they should conform to the guidelines and procedures set by the overall MIS function.

Quite often a data processing system is labelled as a MIS. A data processing system processes transactions and may also have report generation capabilities. A transaction represents an activity such as release from reservoir during a particular interval. An MIS is more comprehensive as it encompasses processing in support of a wide range of organizational functions and management processes. However, there is no doubt whatsoever that transaction processing is one of the essential functions of every MIS.

The obvious question which will come to one's mind is what does it take to transform a data processing system into an MIS. Is a mere addition of a single database, retrieval capabilities and one or two decision models to a data processing system sufficient to declare it an MIS?

These questions are not relevant as MIS is a concept and orientation towards which an information system design moves rather than an absolute state. Therefore, the significant issue is the extent to which an information system adopts the MIS orientation and supports the management functions of an organization. The answer should be a matter of degree rather than a simple yes or no.

Another important aspect about MIS is its capability to provide analysis, planning and decision making support. Such capabilities are not available with the routine data processing system. An MIS orientation implies that users have access to decision models and methods for querying the database on an adhoc basis. A MIS orientation also means that information resources are utilized to improve decision making and to achieve organization effectiveness.

MIS FOR FMIS

FMIS are generallty smaller-scale irrigation systems in which most management activities are carried out and decisions made by the farmers themselves, with the government agencies providing (at most) periodic technical support (IIMI 1991). It has been observed that FMIS are frequently faced with major problems related to operation and maintenance (O & M).

A well-developed MIS has potential to be an effective tool for supporting FMIS. As has been discussed earlier that MIS is an orientation which supports the management functions as defined by the management. It can take care of any information requirement defined and designed in its formulation. In the present paper an attempt has been made to cater to some of the O & M information requirements of an FMIS.

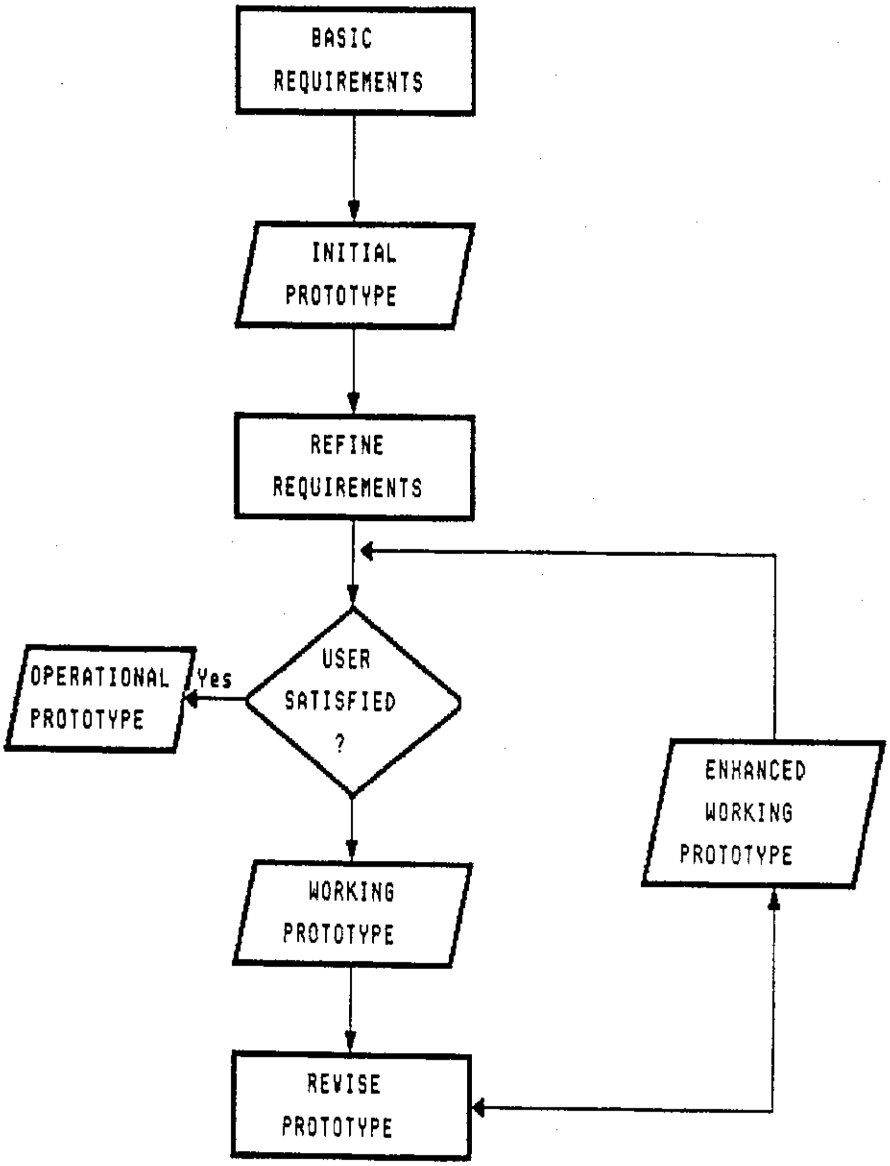
MIS Development Process

There are different approaches available for the development of an MIS. The MIS applications are made to fulfill the requirements as defined by the users. But the degree to which these requirements can be accomplished by the application, which is commonly termed as requirements-development-assurance (RDA), vary to a large extent. Therefore, many application development strategies or approaches have become available varying mainly in their power to achieve RDA. Also, there are many factors which are known to influence the RDA; some of which are, project size, degree of structuredness, user task comprehension, and developer task proficiency (Gosain 1991).

Two popular approaches used for system development are the life cycle approach and the "prototyping approach." The life cycle model is used when the application systems are large and highly structured, user task comprehension and developer task proficiency are high. It has a well defined process by which an application is conceived, developed and implemented. Three major stages are recognized in the life cycle approach. These are: definition stage, development stage, and installation and operation stage. On the otherhand, the prototyping approach to application system development is used when requirements are difficult to define in advance or when requirements may change considerably during development. The prototyping methodology is based on the simple proposition that people can express what they like or do not like about an existing application system more easily that they can express what they think they would like in an imagined future system. Prototyping an application system is basically a four step process in which the user(s) and the system designer are equally involved. These steps are:

- Identification of user's basic requirements
- Development of the initial prototype system
- Use of prototype system by user to refine requirements.
- Revision and enhancement of the prototype system.

Figure 1: Prototype development model



The whole procedure is depicted in Figure 1. Steps 3 and 4 are iterative and the number of iterations may vary from application to application, since the iterations are carried on till the user is satisfied with the system. At this stage the system becomes 'operational prototype' and is distributed for use. However, it may be modified at a later stage.

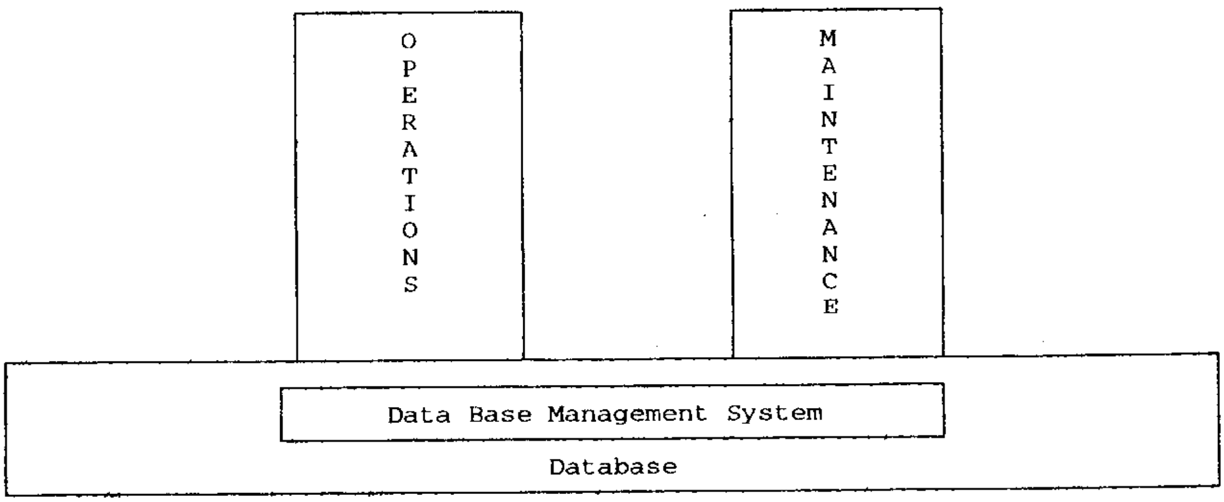
The prototyping approach is recommended for FMIS and an initial prototype has been suggested. The structure of the prototype MIS envisaged is discussed in the succeeding section. Besides discussing the functional subsystems and the activities recognized in each one of them, some of the issues and requirements pertaining to MIS development are also presented.

The prototype MIS conceived and presented here may not be applicable as such to any specific system but it demonstrates some of the possible usages of the MIS as a planning support tool for assisting FMIS. The actual functions which an FMIS shall be required to perform may vary from system to system, however, it would not be difficult to formulate a general-purpose MIS which may cater to the requirements of most FMIS. The resource material already collected and compiled through the FMIS Network as well as through series of workshops conducted by the International Irrigation Management Institute (IIMI) shall prove to be very useful in identifying the common requirements if a general purpose MIS is to be attempted.

STRUCTURE OF THE PROTOTYPE MIS

Presently, two functional subsystems pertaining to O & M have been identified. These subsystems are to be integrated through the use of a common database (Figure 2). The common database helps achieving integrity of data and also avoids its duplication. A data item which is stored or updated through one subsystem will also be available to other subsystems.

Figure 2. Functional subsystems of prototype MIS for FMIS



The subsystem on operation is supposed to be more complex and thus it shall be further elaborated. The operation subsystem can possibly have two broad components, one dealing with the operation of main system and the other dealing with the operation of water delivery below the outlet (Figure 3).

Figure 3. Operation subsystem

OPERATION SUBSYSTEM
MAIN SYSTEM
DELIVERY SYSTEM

The above subdivision is reasonable because of the fact that the treatment required for these two aspects is considerably different. The main system operation shall require the use of simulation models which are based on the hydraulic principles and require data pertaining to the hydraulic structures as well as the canal geometry and related elements (Gosain and Purohit 1991). If the farmer has been handed over the management below the outlet, which is more often the case, then this component may not be required at all. In the prototype used for this paper, such has not been implemented.

On the other hand, the treatment for delivery system below the outlet shall be quite different. It shall involve procedures dealing with soil water balance and scheduling of irrigations. In majority of the FMIS the farmer may be mainly interested in this component only.

The delivery system has been conceived to contain the lower level segments as shown in Figure 4. Three major segments namely scheduling, revenue and evaluation have been envisaged besides the segments on data input/edit and database updating.

Figure 4. Details of delivery subsystem

DELIVERY SYSTEM
DATA INPUT/ EDIT
IRRIGATION SCHEDULING
REVENUE
EVALUATION
UPDATE DATABASES

This structure has been based on the author's understanding of the general requirements of an FMIS. However, it will need a thorough scrutiny by the users and shall be updated to incorporate the additional requirements. That is why the present form should be treated as only an initial prototype.

DESIGN OF THE PROTOTYPE MIS

Design details of various segments of the delivery system as implemented have been presented. The other subsystems shall be added after a better understanding of the requirements of FMIS has been obtained.

Data Input/ Edit

The database is the most important component of any system as almost are other components make use of this component in one way or another. The two major attributes which the database must possess are the integrity and retrieval efficiency. Integrity is achieved by ensuring that no element of the data is duplicated across the database. But, in order to achieve high efficiency in retrieving the data it is very important that the database is very well designed in terms of segregating different elements of data under separate files on the basis of their relationship with other elements as well as the frequency of their use.

The data as required for operation below the outlet as well as some other requirements envisaged for FMIS has been organized under various heads(Figure 5).

Figure 5. Structure of data input/ edit component

DATA INPUT/ EDIT
STATIC DATA ON FIELDS DYNAMIC DATA ON IRRIGATIONS DATA ON CLIMATE DATA ON CROPS REVENUE DATA

One problem which is unique to irrigation projects is that some of the elements (water deliveries etc.) are expressed with respect to the irrigation system layout whereas some other elements (field number, revenue, etc.) are represented with respect to public administration system which is village based. This can create lot of problems on integrity of data. Therefore, a system has been evolved in which every field has been given an identification number with respect to the irrigation network hierarchy and the conventional land revenue number. With this treatment it will be possible to perform any analysis or evaluation with respect to the system hierarchy or the administration hierarchy. The ID number is a thirteen character number and is unique even over various project. It includes the information on project, main canal, branch canal, distributary, minor, sub-minor, outlet and field number.

The static data on field include all data which do not change over time or change very infrequently. These include land revenue number of the field, data related to ownership, data on soil, data on physical layout, etc. These data are arranged in various files as per the design. It needs to be inputted only once in the life of the system. It is not feasible to further elaborate these aspects due to paucity of space. The details can be discussed at the time of the presentation of the package during the workshop.

The dynamic data on irrigations include all the data elements which change within as well as over the seasons. These include irrigation record on each field and the crop grown, water deliveries and levels at control points, etc. The data on climate is required for irrigation scheduling using the scientific techniques which takes into account the soil water and plant relationship.

The data on crops is to store the characteristics such as crop coefficients, root zone depth, etc., of the crops which shall be used to estimate the crop water requirements. If equitable distribution is in use then these data may not be required.

The revenue data has been kept with a view to create a facility for the FMIS to handle water revenue computations. It will include the data on charges to be levied for each crop and the details on the balance due from each farmer. It may also include data pertaining to penalties levied on the farmers violating certain rules. All these data can also be edited, in case of error, or updated, in case of change of information using the same module.

Irrigation Scheduling

The capability to work out the irrigation schedules is a very basic facility which needs to be provided in a FMIS. There are numerous methods prevalent all over the world. Some of these methods have been evolved over hundreds of years and have socially been accepted in the specific societies. It is important that these methods be retained. On the contrary, attempts to enhance their usefulness by modeling them into systems should be avoided. At the same time it is imperative that alternative methods of water scheduling should also be incorporated into such an MIS to facilitate experimentation by FMIS of alternative methods. When subsequently evaluated such alternative methods may help the FMIS to adopt more appropriate methods of scheduling. Figure 6 shows the components provided under the irrigation scheduling module.

Figure 6. Structure of irrigation scheduling

IRRIGATION SCHEDULING
EQUITABLE DISTRIBUTION
USING CROP WATER REQUIREMENT
QUERIES
REPORTS

In the Northern States of India a method of equitable distribution of water, warabandi, is being used. The same has been modeled in the prototype. Provision has also been made to work out the irrigation schedules based on the crop water requirements. Further, options have been provided to adopt constant depth, constant interval or variable depth interval methods of irrigation. These methods have varied suitability under different systems of water supply. The segments on queries and reports are essential to provide facility for FMIS to either get the required information interactively through the query system or as a hard copy through the report system.

Revenue

The module on revenue shall be of immense use to those FMIS where the revenue computations and collection are to be managed locally. It will provide all the facilities of computing water charges, raising bills to the individual farmers, ledger keeping, consolidating revenues at various levels, etc. Only three components as shown in Figure 7 have been envisaged.

Figure 7. Structure of revenue component

REVENUE
COMPUTATIONS
QUERIES
REPORTS

The component on computations shall facilitate the determination of the charges and will update the revenue information in the databases. The queries and reports have similar facilities with the only difference being that the format used for presenting the information shall be different to suit the output media.

Evaluation Module

This module has been aimed at providing FMIS managers with a tool to evaluate their system. Evaluation can be done with respect to various efficiencies. Such facility can be really useful in identifying problems in the FMIS. The level of efficiencies shall also reflect the general scope of improvement. Additional items pertaining to evaluation of FMIS may be included to support different decision and planning objectives.

Update Databases

This is a facility provided to update the databases at any time. This is required because there are many elements of information which are derived from raw data. Such information does not become available unless the system is running. Therefore, in order to make the system up-to-date this segment must be activated. This shall also be required when some error in the database is detected and rectified.

CONCLUSIONS

An initial framework for a prototype MIS for FMIS has been conceived and formulated. The intent of the MIS is to help better manage or assist FMIS. The MIS is a tool for managers to know and support their systems. It provides simple analysis tools and sets the stage for performance evaluation. It is only an initial prototype and needs to be refined considerably before it can be accepted either as a specific or general purpose application. Only a beginning has been made and there is yet a long way to go.

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The Irrigation Management Information System: A Management Tool for the National Irrigation Administration of the Philippines

Avelino M. Mejia[4]

INTRODUCTION

In the mid-70's, NIA developed and implemented on a pilot scheme a monitoring and evaluation (M&E) system with financial assistance from the World Bank. Another M&E scheme was formulated and adopted for the irrigation projects funded by the Asian Development Bank (ADB). These M&E systems were integrated in the early 80's and were used as the standard procedures for all foreign assisted irrigation projects.

In the course of implementing the integrated M&E systems a major constraint was encountered by NIA. The major constraint was where to find the funds to finance the continued implementation of the program after the project has been completed or the loan has been closed. Cognizant of the gravity of the problem and its implications on NIA's drive for financial viability, the World Bank mission which reviewed the program in early 1984 recommended to NIA the development of a simplified and affordable M&E system. Thus, the Irrigation Management Information System (IMIS) was born. This paper presents the concepts, procedures and lessons learned in installing IMIS in national as well as in farmer-managed irrigation schemes (communal systems).

Irrigation development in the Philippines has taken an accelerated pace in the past two decades and there are now about 1.5 million hectares (ha) of irrigated area, which is about 50% of the total area identified as potential irrigable land.

There are two major categories of irrigation systems in the country according to management responsibilities. These are the public schemes or the national irrigation systems (NIS) which are constructed and operated by the National Irrigation Administration (NIA)[5] and the farmer-managed communal irrigation systems (CIS) which are owned and operated by the farmers themselves through their irrigators associations (IA). The farmer participatory approach was initially introduced in the CIS and later in the NIS as well. Most of these NIS are now jointly managed by IA and NIA under different forms of O&M contractual arrangements depending

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[4] Department Manager, Institutional Development Department, National Irrigation Administration, Philippines and serves as Community Irrigation Development Specialist Consultant to the Department of Irrigation, Nepal for the implementation of the ADB assisted Irrigation Sector Project. The management of the operation and maintenance of NIS is lodged under the responsibility of an Irrigation Superintendent. He is assisted by an Assistant Irrigation Superintendent and field staff which primarily consist of Watermasters who are in charge for area divisions of about 750 ha, and Ditchtenders. A typical organizational structure for NIS is shown in Figure 1.

[5] The NIA is a government-owned and controlled corporation created under Republic Act 3601. It is attached to the Department of Public Works and Highways (DPWH). It maintains 11 Regional Irrigation Offices (RIO), 92 national Irrigation Systems Offices (ISO) and 67 Provincial Irrigation Offices (PIO).

on the size of the system service area and the capability of the IA to assume O&M responsibilities.

NIS generally serve systems that are over 1000 ha in extent. The total irrigated area covered by these systems is about 625,000 ha. The CIS have less than 1,000 ha service area. The total irrigated area is about 700,000 ha. In addition to these two types of system are pump irrigation systems covering about 150,000 ha and which are owned and operated by NIA or farmers. Farmers served by the NIS pay NIA an irrigation service fee (ISF) of 2 and 3 cavans[6] of paddy per ha for the wet and dry seasons, respectively. Farmers served by a CIS that received financial assistance from the NIA have two options: (a) put up an equity counterpart equivalent to 30% of the direct construction cost within the construction period or (b) put up at least 10% equity during construction and amortize the remaining amount at a rate of 1.5 cavans per ha for a maximum period of fifty (50) years without interest.

IMIS Framework Development

In its desire to provide better quality of service to the irrigation beneficiaries NIA has been continuously formulating innovative programs and strategies geared towards improving irrigation system efficiency and productivity. One such program is the Irrigation Management Information System (IMIS) which was formulated in mid-1984 with the review of the World Bank assisted Input-Output Monitoring Program (IOMP) and subsequent discussions with the Asian Development Bank (ADB). IOMP was developed and implemented in 1976. The ADB-sponsored Project Benefit Monitoring and Evaluation System (PBME) was launched in 1978. These two M&E systems were integrated in the early 80's and the emerging system was used as the standard procedure for all irrigation projects implemented by NIA with foreign financial assistance. Simultaneous with the adoption of the integrated M&E systems, NIA introduced an improved O&M monitoring and reporting system for the existing agency-managed irrigation schemes.

In the course of implementing the NIA encountered a major constraint in the foreign loan assisted irrigation projects NIA encountered a major constraint. This was where to source the funds to sustain the implementation of the program particularly after the completion of construction or closure of the loan. Another problem identified was the number of parameters being monitored and the duplicity of data and information being gathered with those already being obtained by other agencies. Cognizant of these problems and difficulties and their implications on the continuity of some aspects of the earlier M&E programs, the World Bank mission advised NIA to develop a simplified and affordable M&E system responsive to its information needs, the implementation of which should be financed entirely from the agency's internal coffers. Thus, IMIS was born.

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6 A cavan has an equivalent weight of 50 kg.

IMIS OBJECTIVES

The IMIS framework is hinged principally on the simplication of NIA's existing monitoring and evaluation systems to form a low-cost but effective management information system with the end view of promoting the attainment of NIA's vision ..."building a dynamic and functional NIA-IA relationship working in partnership to accelerate irrigation development and provide an efficient level of irrigation service." Broadly defined, IMIS is an integrated mechanism of planning, periodic monitoring and evaluation of irrigation system management practices, farming operations and the corollary agricultural support services through timely data and information gathering in order to systematize the institution of appropriate actions. Specifically, IMIS as a management tool aims to:

1. Provide irrigation managers with timely information on:

   1.1 needs of farmers in complying with programmed water deliveries so that these could be attended to by the irrigation system or coordinated with concerned agencies;

   1.2 condition of irrigation facilities and structures which are likely to affect water use efficiency and cropping intensity;

   1.3 farming activities to guide adjustments in water deliveries and for timely preparation of irrigation service fee (ISF) bills; and

   1.4 problems which are likely to affect ISF collection and financial viability of the irrigation system.

2. Evaluate differences between targets and accomplishments so that appropriate management actions to correct the causes of the deficiencies could be instituted.

3. Provide a basis for evaluating the performance of O&M personnel that of the IA with contracts and for developing a credible package of reward and punishment.

PROGRAM COMPONENTS/ FEATURES

IMIS has three (3) major components; namely, the Irrigation Service Improvement Plan (ISIP), the System Management Committee (SMC) and farmer participation. Each of them are described fully below:

Irrigation Service Improvement Plan (ISIP)

This is a short-term plan integrating the various programs/activities towards improving the performance of irrigation systems. ISIP, which has a horizon of 3 to 5 years, integrates the various existing O&M plans of the various agri-institutional activities to be pursued including specific statements of affordable and attainable commitments.

The resulting plan has the following components: a) physical improvement/restoration works b) operation strategies and programs c) institutional development activities d) agricultural support services and production targets; e) financial viability goal; and f) budgetary requirements. An indicative outline of ISIP is shown in Appendix 1.

The initial is prepared by the Irrigation Superintendent in coordination with the heads of the various agencies and institutions providing corollary agricultural support services. Seasonal summary of programs with the corresponding committed requirements and targetted outputs shall be prepared and disseminated to the irrigation beneficiaries at least one month prior to the initial water delivery. At the end of the season a review of accomplishments shall be made with the various agency heads and the irrigation beneficiaries through their Irrigators Associations (IA). The seasonal review shall include adjustment of targets as well as renewal of commitments for the next season's operations. Based on the levels of achievements monitored by IMIS, the plan should be reviewed and evaluated on an annual basis, the targets reset based on affordable and attainable commitments, and its coverage extended for another year (roll-on planning).

System Management Committee (SMC)

To ensure maximum utilization of data and information; that is, identified problems are properly diagnosed and acted upon on time, a System Management Committee (SMC) shall be established at the system level. Chaired by the Irrigation Superintendent the SMC membership shall be composed primarily of the relevant staff of the irrigation office and farmer-representatives particularly the IA Presidents/Officers. Depending on the size of the system service area similar committees shall likewise be organized at the field levels: zone, SWMT sections and WM divisions. The SMC shall serve as a forum for discussing the various problems, difficulties, opportunities and other factors impinging on the operations of the irrigation system. With regular participation from the farmers in the systems operations planning, implementation and monitoring better rapport between the O&M personnel and the farmers would be established. Furthermore, with full farmer participation in the decision-making process for improving the performance of the irrigation system, coordination with other agencies for the delivery of corollary assistance programs could be facilitated. In fact, in due time farmers' involvement will result in direct coordination by the farmers themselves with the relevant agencies to ensure the delivery of support services in the right amount, at the right time and at the right place.

Farmer Participation

As briefly discussed in the preceding sections, most of the NIS are now jointly managed by the IA and NIA under various forms of O&M contractual arrangements. As the IA's capability to handle O&M responsibilities increases, NIA's involvement in routine O&M tasks decreases. One major responsibility delegated to the IA is the recording and reporting of irrigated areas, distribution of ISF bills and collection of ISF payments. Besides system O&M, a few IA have already engaged in other ventures such as production credit re-lending, agricultural inputs distribution, marketing, establishment of cooperative stores and similar undertakings all geared towards improving the collective productivity and income of farmer-members.

Coupled with the delegation of O&M activities to the IA is the implementation of IA-capability building programs through seminars, trainings and workshops which include the installation of the IA Management Information System (IAMIS). The major objective of the program is to develop the capacity of the IA to make sound decisions based on the information that they themselves gather. As a result, the IA will have a more credible stance in the SMC discussions and in the decision-making process for improving the management of the irrigation system.

IMIS PROCEDURES[7]

Data Gathering and Reporting

There are five major operational areas monitored under IMIS; namely, a) ISF billing and collection, b) financial viability of the system, c) operation and maintenance cost, d) cropping intensity, and e) crop production. Monitoring is conducted at four levels: (i) the service area of each major canal managed by a Watermaster or an IA within a system, (ii) the irrigation system, (iii) all NIS supervised by a Regional Director, and (iv) NIA's Central Office. Data is filed in microcomputers in the Irrigation System Office from which several reports are prepared.

IMIS consists of four primary reporting formats which are briefly described below.

Form 1: Record of Farming Activities which is a list of all landowners and tenants, farm size and schedule of cropping activities in an area of about 750 ha which is covered by a watermaster. The list of farmers served by the canal is revised by the watermaster at the beginning of each season and data about the status of farming and crop production activities are updated each week during the season. The record is retained by the Watermaster as a working document. A specimen of IMIS Form 1 is attached as Annex 1.

Form 2: Report of Planted and Billed Areas is used to prepare the ISF bills of individual farmers serviced by the system within the cropping season. It is prepared on a weekly basis immediately after a farm lot is planted. Part A is prepared by the watermaster. It identifies the landowner or tenant who receives the irrigation service and who should received bills for ISF while Part B which is done by the Billing Clerk. It presents the data used to compute the bill for ISF. A specimen of IMIS Form 2 is attached as Annex 2.

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7 IMIS is presented as Appendix 4 of an ADB publication: Benefit Monitoring and Evaluation: A Handbook for Bank Staff, Staff of Executing Agencies and Consultants. March 1992. Manila

Form 3: Report of Farming Activities, Actual Water Supply and Problems Encountered This is used to program water deliveries and schedule repairs or maintenance work. This report is prepared each week by the watermaster and is submitted to the irrigation superintendent (IS) who, in turn, uses the information to program adjustments in water delivery, identify repair works or other remedial activities to be undertaken. Form 3 is the main source of information for discussion in the SMC meetings. It is prepared in triplicate with the original copy submitted to the IS. In large systems, a duplicate copy is submitted to the supervising water management technologist who is in charge of a section area of about 2,500 ha or the Zone Engineer who supervises an area of about 10,000 ha. The third copy is retained by the Watermaster. A specimen of IMIS Form 3 is attached as Annex 3.

Form 4: Monthly O&M Report This report is prepared by the IS and is submitted to the regional director and to the manager, systems management department (SMD) of NIA central office. Information presented in this one-page report reflects both planned and actual discharges, area irrigated and area planted, area harvested and area benefited, area billed and ISF collections, as well as the financial status of the irrigation system. SMD reviews the reports and comes up with actions based on priorities, and then compiles the information in microcomputers. At the end of the year, SMD produces a summary which, in turn, is used to evaluate the performance of the irrigation systems.

System Performance Review and Evaluation

At the end of each cropping season and at the end of each year, data gathered are consolidated and compiled into reports which describe the performance of the irrigation system during the season or year under review in accordance with the five major operational areas described above. With time series information, regional directors and staff of the central office can evaluate the performance of the individual systems and institute appropriate action on a timely and objective manner. Similarly, the IS can objectively evaluate the performance of the individual responsibility centers (which include IA-managed areas) under his supervision. Based on the evaluation results, the IS can have a credible basis for distibuting viability incentive grants (VIG) to his staff and for computing the IA's share in the ISF collection. A sample performance evaluation report is presented in Table 1 while Table 2 shows the flow of data and information including the needed action from each responsibility center upon receipt of the reports.

Besides performance evaluation, the IMIS reports are being used by the NIA's SMD in preparing for the strategy planning workshops that are conducted annually by the regional directors.

Table 1. Annual performance report: Santa Cruz River Irrigation System

	DIVISION LEVEL														SYSTEM LEVEL	
	STA. CRUZ RIS				MABACAN RIS		MALAUNOD RIS		BALANAC RIS		LUMBAN RIS					
	DIVISION A		DIVISION B													
INDICATOR	Dry '90	Wet'90	Dry '90	Wet '90	Dry '90	Wet '90	Dry '90	Wet '90	Dry '90	Wet '90	Dry '90	Dry '90			Dry	Wet
Service Area (ha)	1,856	1,856	1,869	1,869	590	590	228	228	935	935	97	97			5,575	5,575
Program Area (ha)	1,400	1,613	1,200	1,213	500	545	220	228	700	793	80	57			4,400	4,449
Irrigated Area (ha)	1,211	1,291	1,238	1,233	515	397	226	229	885	763	78	56			4,156	3,972
benefited Area (ha)	1,333	780	1,182	1,143	515	138	226	223	885	638	78	56			4,021	2,709
Yield/ha		862													0	0
Cropping Intensity (%)	81	59	99	52	103	54	103	102	126	70	99	99			98	61
ISF Current Collectible	849,758	472,484	886,858	313,435	386,995	146,562	169,874	116,006	663,782	278,169	59,106	28,279			3,016,375	1,354,938
ISF Current Collection	387,241	267,588	286,820	174,439	127,777	84,537	25,030	23,766	243,997	122,262	14,923	14,559			1,085,790	687,152
Total BA Collected	174,844	138,493	109,981	39,089	69,787	7,096	34,902	8,462	47,158	55,623	5,172	6,740			441,846	255,506
Total Income	8,386,239	8,186,761	8,894,268	8,661,144					3,226,443	3,690,430	431,867	232,388			30,525,674	31,099,831
Other Income	562,085	506,080	396,802	213,529	197,565	91,634	59,932	32,229	291,156	177,885	20,095	21,299			1,527	942,659
Target Collection	1,050	0	0	0	0	0	0	0	0	0	0	0			1,050	0
Collection Efficiency	66	85	44	68	51	62	35	27	43	34	34	75			50	69
Total Expenses	327,217	407,382	318,659	387,062	105,513	169,565	82,839	73,572	259,886	7,209	7,209	16,758			11,101,435	1,319,061
Net Income	235,918	(1,301)	78,142	(173,533)	92,051	(77,951)	(23,007)	(41,342)	31,259	12,886	12,886	4,541			422,250	(376,402)
O&M Costs/ha (E/SA)	176	219	170	207	178	287	363	322	277	74	74	172			197	236
O&M Costs /ha (E/BA)	289	431	269	617	204	578	366	317	293	91	91	296			273	484
Financial Viability																
a. ISF Collection/Expense (%)	172	100	125	55	187	54	72	44	112	67	279	127			139	71
b. Total Income/Expense (%)	172	100	125	55	187	54	72	44	112	67	279	127			139	71

Table 2. IMIS data and information flow

Form No.	TITLE	RESPONSIBLE PERSON/CENTER						
		WM	SWMT/ZE	BILLING CLERK	ASST. IS	IS	RIO	CENTRAL OFFICE
1	Record of Farming Activities	Gathers data and keep records in file	Verifies and Reviews records					
2	Weekly Report of Planted and Billed Areas	Prepares Part A using data from Form 1	Reviews report of planted areas	Using data from Part A, Prepares ISF bill (Part B)	Reviews bills prepared	Approves bills		
		Distributes bills						
3	Weekly Report of Farming Activities, Actual Water Supply and Problems Encountered	Prepares reports	Reviews reports and prepares summary with recommendations		Consolidates information at systems level	Reviews information and institutes needed actions		
4	Monthly O&M Report				Prepares the systems O&M report	Reviews and checks report and submit same to Regional Office. Acts on recommendations. Conducts staff meetings to assess performance and map out strategies	Consolidates reports at regional level and submit same to Central Office w/in 15 days after end of the month. Acts on recommendations. Prepares feedbacks.	Prepares national summary and acts on recommendations. Prepares feedbacks.

Other NIA Benefit M&E Systems

In compliance with the loan covenants entered into by the NIA with the lending institutions, NIA adopts the following standard procedures for the implementation of irrigation projects with foreign financing:

Benchmark Agro-Socio Economic Studies (BASES)

These are conducted in newly started irrigation projects to update the agro-socio economic data and information about the project. This project-wide survey uses sample farmer-respondents who are randomly selected from a comprehensive listing of all households in the command area. Besides the listing of households there are two types of major surveys conducted using pre-formatted interview schedules: a) farmers survey and b) institutional level survey. The farmers survey focuses on updating data and information about household income and expenditures, farmers crop practices, sources of farm capital, use of credit and agricultural inputs, extent of farm mechanization, etc. The institutional survey is carried out to assess the existing capacities of extension agencies, input and credit suppliers and to determine the actual scope and accomplishments of related programs such as agrarian reform, cooperatives development and the like. All these information are used in formulating agri-institutional development plans and strategies with the end view of ensuring gradual accrual of the intended benefits from the project.

Farm Management Surveys (FMS)

A usual component of an irrigation project is the establishment of pilot demonstration farms which are intended as show-windows for the project beneficiaries on improved agricultural production techniques and irrigation water management practices. To monitor the changes in crop practices and their effects on production, several rounds of farm management surveys are conducted within a cropping season. These surveys are timed with the stage of farming activity or crop growth.

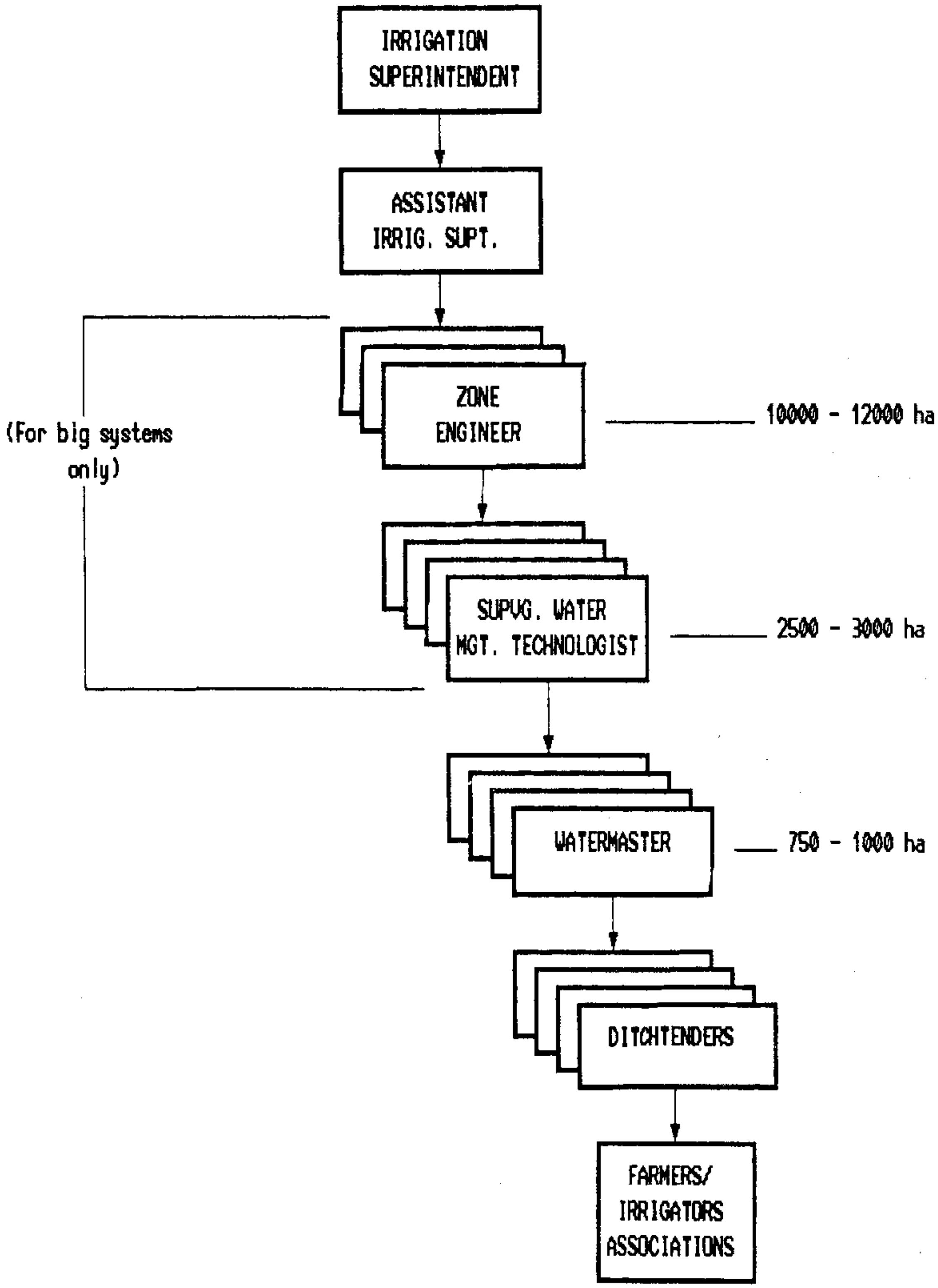
Regular O&M M&E

For existing irrigation service areas and the new areas generated in on-going irrigation projects the regular IMIS forms are used.

Provisional Impact Evaluation (PIE)

This is being implemented in newly completed irrigation projects to determine and assess the development changes that occurred during project implementation. The results also serve as the benchmark in formulating the Irrigation Service Improvement Plan (ISIP) for a newly completed project and in the preparation of the Project Completion Report (PCR). It is to be noted though that the availability of project funds is a prime factor in the conduct of the PIE.

Figure 1. Organization structure of a typical irrigation system



(Page ___ of ___ Pages)

RECORD OF FARMING ACTIVITIES

CANAL/DIVISION : ________

SEASON/YEAR : ________

IWD

TURNOUT NUMBER : ________

PROGRAMMED AREA : ________

TARGET DATE: ________

SERVICE AREA : ________

ACTUAL DATE: ________

LOT NO.	NAME OF LANDOWNER	NAME OF TENANT	SERVICE AREA (ha)	RICE PRODUCTION					OTHER CROPS			STATUS OF FARMING ACTIVITIES INCLUSIVE DATES and WEEK NO.							REMARKS
				Planted Area (ha)	Variety	Weeks to Mature	Harvested Area (ha)	Gross Production (cav)	Name of Crop	Area (ha)	Gross Production (kg)	1	2	3	..	..	..	n	
(AREA UNDER LAND/SOAKING/PREPARATION)											AULS/LP								
(AREA UNDER CROP MAINTENANCE)											AUCM								
(AREA PLANTED TO OTHER CROPS)											APOC								
(AREA UNDER TERMINAL DRAINAGE)											AUTD								
(AREA HARVESTED)											AH								

Annex 2. IMIS Form 2

IMIS FORM 2
(Page __ of __ Pages)

WEEKLY REPORT ON PLANTED AND BILLED AREAS

CANAL/DIVISION : ________
TURNOUT NUMBER : ________
SERVICE AREA : ________

INCLUSIVE DATES: ________
WEEK NO. : ________

PART A 1/							PART B 2/						REMARKS
LOT NO.	NAME OF LANDOWNER/ CULTIVATOR	ADDRESS	FARM AREA (ha)	PLANTED AREA			BILLED AREA (ha)	AMOUNT OF BILL			BILL NO.	DATE OF BILL	
				RICE (ha)	OTHER CROPS			CA 3/ (ha)	BA 4/ (kg)	TOTAL (kg)			
					NAME	(ha)							

NOTES:
1/ Part A is prepared by Watermaster with information from IMIS Form 1.
2/ Part B is prepared by a Billing Clerk.
3/ CA refers to Current Account (Irrigation Service Fees).
4/ BA refers to Back Account including penalties/surcharges.

Annex 3. IMIS Form 3

WEEKLY REPORT OF FARMING ACTIVITIES, ACTUAL WATER SUPPLY
AND PROBLEMS ENCOUNTERED

(Page __ of __ Pages)

DIVISION/SWMT SECTION/ZONE : ________
SERVICE AREA : ________

INCLUSIVE DATES: ________
WEEK NO. : ________

CANAL/ DIVISION	PA (ha)	AULS (ha)	AULP (ha)	AUCM (ha)	APOC (ha)	AUI (ha)	AUTD (ha)	AH (ha)	AWS (mm/d)	RA (mm/d)	PROBLEMS ENCOUNTERED		
											NATURE	EXTENT	
												NO. OF FARMERS	AREA AFFECTED (ha)
TOTAL													

PREPARED BY: ________

NOTES:

PA - Refers to Programmed Area.
AULP - Refers to Area Under Land Preparation.
APOC - Refers to Area Planted to Other Crops.

AUTD - Refers to Area Under Terminal Drainage.
AWS - Refers to Actual Water Supply during the week in mm/day.
RA - Refers to the Actual Rainfall during the week in mm/day.

AULS - Refers to Area Under Land Soaking.
AUCM - Refers to Area Under Crop Maintenance.
AUI - Refers to Area Under Irrigation which is the sum of AULS + AULP + AUCM + APOC.
AH - Refers to Area Harvested.

MONTHLY O&M REPORT

________________, 19___

Irrigation System: ________________ Region: ________

Cropping Season : __________ Programmed Area: ____________ (ha)

Estimated ISF Collectibles: ₱ ________________

AREA CATEGORY/SECTION					SYSTEM LEVEL	TOTAL
NAME OF WM/SWMT/ZE/IA						
1. AIWS (lps)						
2. Actual Rainfall (mm)						
3. No. of Rainy Days						
4. Farming Status (ha)						
4.a AULS/LP						
4.b AUCM						
4.c Harvested						
5. Area Billed (ha)						
6. Current ISF Collectibles (₱)						
7. ISF Collection						
7.a Current Account						
7.a.1 In Cash (₱)						
7.a.2 In Kind (kg)						
7.b Bank Account						
7.b.1 In Cash (₱)						
7.b.2 In Kind (kg)						
8. Other Income (₱)						
9. Total Income (₱)						
10. Expenses: O&M (₱)						
11. Expenses: Repair & Improvement(₱)						
12. Total Expenses (₱)						
13. SAA Received: O&M (₱)						
14. SAA Balance : O&M (₱)						
15. Maintenance						
15.a No. of DT's Sections						
15.b No. of Sections Satisfactorily Maintained						

Prepared by: ________________ Checked and Submitted by: ________________

Date Prepared: ________________ Date Submitted: ________________

Reviewed and Evaluated by: ________________

NOTES:

AIWS refers to the daily average Actual Irrigation Water Supplied; AULS/LP refers to the Area Under Land Soaking/Land Preparation during; AUCM refers to Area Under Crop Maintenance during the month; SAA refers to the Sub-Allotment Advice or the amount of money received by the Irrigation System or Section thereof for regular O&M activities and for Repair and Maintenance; DT's section refers to the section of canal maintained by a Ditch Tender which is about 3.5 km of earth canal.

Appendix

INDICATIVE OUTLINE FOR IRRIGATION SERVICE IMPROVEMENT PLAN (ISIP)

The NIA's pursuit of improving the efficiency and productivity of its existing as well as its recently completed irrigation systems could be greatly enhanced through proper integration of the various activities in irrigation and farming operations at different O & M responsibility levels. The requirements in improving irrigation service could be spelled out in an Irrigation Service Improvement Plan (ISIP), which could be coupled with realistic output targets and used together commitments from the irrigation authorities and other service agencies for their mutual support to program implementation. Specifically, the ISIP hopes to integrate and operationalize the vision and strategies identified in the NIA's Corporate Plan in each major scheme or administrative groupings of irrigation systems. As the plan emphasizes on the carrying out of short-term covenants and agreements, it should be of medium-range coverage (from 3 to 5 years).

For the guidance of Irrigation Superintendents and all others concerned, the following indicative outline could be used in the formulation of an Irrigation Serice Improvement Plan (ISIP):

BACKGROUND INFORMATION

This describes in summary the irrigation system which may include its location, service area, water resources, soils and land use, population, management structure, etc. Location and service area layouts should be included indicating thereon boudaries of the irrigation system, municipalities served, canal and road networks, major structures, etc.

CURRENT STATUS

Contains description of the physical and institutional profile of the irrigation system such as irrigation service, land use, cropping intensity, productivity and viability, institutional development efforts and other programs initiated and/or currently being undertaken. Sub topics are the following:

Service Area

Extent of coverage of the irrigation system which may include a presentation of the discrepancy between the design and actual service area; number of barangay and municipalities covered; area coverage by WMT/WM section or by major canals (main lateral and sub-lateral canals); areas which under normal water supply cannot be served with irrigation during the dry season because of topographical limitations; areas with drainage/flooding problems during wet season; etc. To facilitate presentation, a system layout indicating the various features of the service area should be attached.

Physical Profile

Introduction may include when the system was constructed and/or rehabilitated; costs involved; fund sources, etc. Detailed presentations should be made on the physical status of the various facilities and structures; number of defective/dysfunctional units and their location; priority repair works (and costs involved) to be undertaken to improve the irrigation system performance.

System Water Supply

Present some detailed description of the water source(s) of the irrigation system which may include analysis of the water supply conditions including rainfall in the area; location of gaging and/or hydromet stations; procedures of water allocation and pattern of distribution at the system level for both wet and dry cropping seasons.

Land Use, Cropping Intensity and Productivity

Present the current land utilization and cropping pattern in the area in both wet and dry seasons and by WMT/WM section. Analytical presentations may include the extent of irrigation service by kind of crop; annual cropping pattern; farming practices and yield levels. Some specifics could be a tabular presentation and discussion of the cropping intensity of the irrigation system for the past five years or so, which could include a comparison between planted, programmed and irrigated areas; discrepancies (gaps) between targets and achievements and the reasons behind such differences. Major constraints to improving productivity being encountered by farmers in the area vis-a-vis credit, fertilizers, agro-chemicals, seeds, labor, marketing and pricing shall also be discussed.

Institutional Development

Presents the extent of irrigators organization area of responsibility in terms of: hectare coverage and location of IAs; and the extent of participation of IAs in the operation and maintenance of the irrigation system (O & M turnover). It would also be appropriate to include a general assessment of existing inter-agency coordinating bodies as well as the programs of other agencies involved in promoting irrigated agricultural development in the area and the problems encountered in implementing these programs.

System Viability

Presents the yearly assessment, for the past five years, of income (ISF, equipment rentals,etc.) and expenditures of the irrigation system (or component systems) as well as its viability status.

THREE-TO FIVE-YEAR IMPROVEMENT PLAN

The plan should emphasize the development targets to be achieved on a seasonal or annual basis as well as the specified conditions and requirements in order to achieve such targets.

Suggested topical outline is presented below:

1. *Physical Improvement Works.* Include repairs and/or restoration works prioritized on an annual basis according to their importance in improving the irrigation service. Likewise, additional construction activities should be specified as may be found necessary to expand the service area. Schemes of land development should be included. Details may include job description, location, cost involved and justifications.

2. *System Operation.* Proposed irrigation delivery schedule and cropping pattern, water supply analysis and projections, target irrigated areas, O & M personnel deployment and IA participation in O & M. Details may include target setting by WMT/WM section, zone and District and System levels.

3. *Institutional Development.* Provide brief description of the existing or proposed program framework for organizing farmers into irrigators associations (IAs) and the scheme by which O & M contracts are being or would be effected. Specifics may be the number of IAs to be organized, area coverage, membership and timetable of organizing activities. Other details should include personnel and logistics requirements for organizing farmers and for IA capability building activities and sustenance.

4. *Agricultural Productivity.* In consultation with an inter-agency mechanism and the IAs represented in the system management committee (SMC), set yield and production targets. Agreements should be drawn for the timely supply of farm inputs (seeds, fertilizers and agro-chemicals), credit and other support services. Details should include quantification of the above production requirements on a seasonal or annual basis.

5. *Viability Goals.* On the basis of the projected system improvement works, operation strategies and institutional arrangements set viability levels on a yearly basis. Details should include target setting of ISF collections by O & M responsibility centers (WM/WMT, Zone or District/System Levels).

6. *Budget Estimates.* For the entire period covered by the plan (3 to 5 years), the required budget should be prepared broken down according to activity on an annual basis. For the first year of plan implementation and every year thereafter, present a quarterly cash flow of the funds needed. Justifications should be included particularly in requesting budget for physical improvement/restoration works.

Pilot Inventory of Communal Irrigation Systems in the Province of Capiz

Rudy R. Ibabao[8]

INTRODUCTION

This report is an account of the activities and a presentation of the result of the pilot inventory of all existing National Irrigation Administration (NIA) communal irrigation systems (CIS) in the province of Capiz. The inventory was conducted in June, 1988, by a NIA inter-disciplinary team composed of three technical personnel and four institutional workers, guided by two staff of the Provincial Irrigation Office (PIO) of Capiz, and assisted by two support personnel (Appendix B).

The inventory was first implemented in the province of Capiz as a pilot activity preparatory for its supposed regionwide implementation. As a whole, the inventory of all communal irrigation systems in Region VI was initiated to be conducted by the Planning Section of NIA, Region VI in order to:

1. make a realistic field level assessment and evaluation of the status, both technical and institutional, of all CIS constructed by NIA in Region VI.

2. verify monitoring data such as area, number of farmer beneficiaries, number of structures, etc. on all these CIS and

3. establish benchmark information for these systems.

This report will therefore, attempt to:

1. describe the process and procedures in the conduct of the inventory,

2. identify and assess salient lessons from experiences during the pilot inventory and

3. present in summary the highlights of the findings and observations per the inventory.

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8 Supervising Engineer A, Planning, Investigation and Survey Section, Engineering Division, National Irrigation Administration, Region VI, Iloilo City, Philippines.

METHODOLOGY

Identification of Capiz as Pilot Area

Of the five provinces in Region VI, Capiz, was selected as pilot area for the conduct of the CIS inventory. The selection was based on the discretion of the Regional Irrigation Office (RIO) management as per the recommendation of its Planning Section office.

There were no official guidelines set for the selection of the pilot area but some basic factors relative to conduciveness to the learning from the pilot activity were nevertheless considered. These factors include:

1. Proximity of the CIS to the Capiz PIO;
2. Fewer existing systems in the province as compared with the other four provinces of the Region;
3. Wide range of Irrigators Association's (IA) viability status; and
4. Security considerations.

Formulation of Questionnaire

A questionnaire for the inventory (Appendix A) was prepared one week before the pilot inventory activity, by the Planning Section and the Institutional Development Division staff of the RIO. The questionnaire covered two main areas of concern, the technical and the institutional. The technical aspect centered on the CIS's physical profile and functionality, while the institutional aspect focused on the organizational, CIS management and financial status of the IA.

The questionnaire was first presented to the inventory team during an orientation session on the morning of June 14, 1988. During that session the questionnaire was thoroughly discussed by the group and some revisions were made.

Technical: No significant revisions of the technical portion of the questionnaire were made during the orientation session. Basically, only a clarification of terms was facilitated in order for members of the inventory team to have a common understanding of the data required in filling up the questionnaire.

Institutional: Some changes in the institutional portion of the questionnaire were made during the orientation session. The changes were the inclusion of additional items in the format designed to further highlight certain viability indicators in IA organization and system management. The institutional questionnaire format was finalized on the second day of the session.

Pre-Testing

Pre-testing of the inventory questionnaire was conducted at Salcedo CIS, the first system visited by the team. The pre-testing made way for the further refinement in the format of the questionnaire and also served as insight for the team in estimating the time to be allotted in the actual inventory (walkthrough and interview) as well as other factors to be considered in the conduct of field work.

Respondents

Except for non-operational systems, the respondents during the actual inventory were the farmer-users of the systems being surveyed. In most cases, these farmers were officers of the irrigators associations.

No scientific sampling method was used in the selection of respondents for the inventory. Basically, all IA members (and in some cases other barangay residents) available for interview were tapped as source of information.

> *Technical*: For the technical inventory, the main respondents were identified to serve as guides for system walkthroughs. These respondents were usually the IA water tender or the IA President, or any IA officer who had knowledge of the system's physical layout and characteristics. During the walkthrough, members of the tecnical team also interviewed farmers who they met to further validate their observations and findings.
>
> *Institutional*: Generally, the respondents for the institutional inventory were key officials of the system's irrigators' association such a the IA President, Vice-President, Secretary, Treasurer, Auditor and members of the Board of Directors (BOD) who were knowledgeable of the organizational profile and system management policies and practices of the association. Other IA members were tapped primarily for validation of data and observations.

INVENTORY PROCESS

Schedule of Field Work

To serve as a schedule for field work, the inventory team made a listing of all existing CIS in the province of Capiz, arranged by municipality. As decided by the group (Appendix C), the schedule of field work was municipality based, i.e. systems within a particular municipality were scheduled for visitation on the same day except when access from one system to another was not practicable. No specific dates were, however, designated per municipality/project in order to allow for flexibility in scheduling.

As the team progressed in the inventory of the systems, the names of the systems already visited were deleted from the list by simple cancellation method.

Procedure

In the actual conduct of the field work, a general pattern of procedure had been established, viz:

1) Advance notice - Whenever possible, the inventory team, through the Senior Irrigation Community Organizers (ICO) or the Irrigators Organization Worker (IOW), gave advance notice to the IA regarding the arrival of the team.

2) Courtesy Call - Upon arrival at the system, the inventory team first made a courtesy call to the IA President or to the next higher IA officer when the president was not present.

3) Briefing - After introducing each member of the team, the IA President and other IA officers/members present is then briefed on the purpose of the team's visit. The Sr. ICO or IOW of the system was usually made responsible for introducing the members of the team while the briefing was done by any member of the team.

4) Identification of a local guide for the technical walkthrough and the respondents for the institutional interview.

5) Conduct of system walkthrough and group interview - These activities were undertaken simultaneously except for non-operational systems where institutional interviews were not conducted and also in the case of San Roque CIS where only the IA President was present.

   a) Technical Walkthrough - The physical/technical inventory of the system was conducted by walkthrough with the assistance of a guide (usually IA water tender or IA President). During the walkthrough, starting upstream to downstream or vice-versa, the technical team made a visual inspection of all system canals and structures. A member of the team listed the different existing structures and canal lines, observed and made notations as to their physical status and functionality. Another member of the team, noted down these existing structures and facilities with the use of a layout map, indicating their locations (stationing) as well as their physical status and functionality.

   Diversion discharge calibrations and soil analysis (upstream, midstream and downstream portions) were also conducted during the walkthrough. These were undertaken by one technical member of the team along with the visual geological analysis of the terrain within the vicinity of major structures and facilities (e.g., damsite).

   b) Institutional Interview - The institutional aspect of the inventory was undertaken by group interview and actual inspection of IA records and documents. The group interview was conducted by either of the two institutional members of the team as main interviewer while the other assisted by giving follow-up questions for clarifications. The main interviewer was assigned to fill in the interview questionnaire and was, therefore, responsible for the continuity in asking the main questions per the questionnaire. Follow-up questions were asked in cases when the answers of respondents were not clear or when there was need to probe for more accurate responses.

The interview was followed by actual inspection of IA records and documents (financial and organizational). This was done with the consent and in the presence of the IA officer responsible for the records - IA Secretary, Treasurer, Auditor, etc. Observations in this regard were noted down in the questionnaire.

6. Collation of data/observations - After field work and upon arrival at the Capiz PIO, members of each group (technical and institutional) compared and discussed their respective observations regarding the CIS and the IAs which were visited that day. Each group then came up with a common finalized report per system. Upon finalization of the groups' reports, these were then tabulated by one of the team members.

7. Non-operational Systems - For non-operational systems, only physical/technical inventory were undertaken and the inspection of these systems only focused on the dam and its immediate vicinity. Measurements/dimensions of these structures were taken and whenever possible, the water discharge of the water source was determined.

   The institutional aspect of the inventory of these systems were not taken into consideration since the IAs managing these systems were already non-existent.

CONSTRAINTS/ PROBLEMS ENCOUNTERED AND ACTION TAKEN

A summary of the results of the inventory can be found in the Annex.

Availability of Farmers

The conduct of the inventory was easy in only nine out of the twenty-two communal systems visited in the province of Capiz due to the availability of farmers for the institutional interview and technical walkthrough. In all these nine systems, the IAs were notified in advance, regarding the inventory by the IOWs, one to three days before the arrival of the team.

Difficulties in the availability of farmers were most especially experienced at non-operational systems. There were several communals without institutional organizers assigned and communals with institutional organizers assigned but who were not informed of the inventory or were not at their respective assignments when the inventory team arrived in the area.

Presence of Institutional Organizers

While the institutional organizeers were of significant help in mobilizing farmer IA officers for the institutional interview and technical walkthrough, and in providing additional data relevant to the inventory, their presence during the interview often influenced the farmer's responses to questions asked. This tendency had been most notable in line with questions which imply indicators on extent of institutional inputs - e.g. conduct of meetings, system management planning, record keeping, frequency of NIA personnel visitation, etc.

Weather, Accessibility and Terrain

In five instances within the inventory period, activities of the team had been hampered by heavy rains. This has led to the postponement of the first scheduled field work of the team while in the other four instances, heavy rains occurred while the team was already on field work. Most especially affected by the rains were members of the technical team who, by the nature of their concern, had to conduct walkthrough of all the systems visited. Some members of the team became ill due to overexposure to the weather condition.

Specifically, heavy rains directly affected technical activities like water discharge calibration, measurement of the dam and even visual inspection of structures and facilities. For the institutional survey, the rain had also in one way or another, affected the interviews in terms of farmer's availability and interruptions in the interview process particularly at times when changes were needed and at instances when normal conversations were no longer audible.

The prevalence of the rainy season had also posed problems in the conduct of the inventory in terms of its effect to accessibility and terrain of projects visited. There were instances that travel time were significantly extended due on accessibility problems and poor road conditions.

Time Constraints

The pressure due to limited time in the conduct of the inventory had been most notable in all projects visited (Appendices D and E). Basically, the said problem was due to the delayed start of the conduct of field work on the first three days. The circumstance compelled the inventory team to request for a four day extension of the field work.

It may be noted that the actual inventory of the systems were undertaken at an average of about eighty-eight minutes per project for the institutional interview and about seventy-nine minutes per project for the technical walkthrough.

Transportation

During the first three days of the inventory period, the inventory team was not able to immediately undertake actual field visitation/survey due to lack of transportation. The service vehicle which was used to transport the team from the RIO to Capiz PIO was immediately recalled per instruction from the regional management, with the expectation that another service vehicle would be provided by Capiz PIO.

However, due to the poor condition of the Capiz PIO service vehicle assigned to the team, the schedule inventory did not proceed smoothly until after a vehicle from the RIO, arranged by the Planning Engineer, arrived on June 20.

Annex

SUMMARY OF FINDINGS/ OBSERVATIONS

1) Salcedo CIS

a) Technical - The system had just been rehabilitated in 1987. Except for two tailend structures, siphons at Station (Sta.) 2 + 203 and Sta. 2 + 273, which were observed to have been abandoned, the whole system was found to be fully operational and well maintained.

b) Institutional - The irrigators' association managing the system manifested indications of viability. It has system management plans which are being strictly followed by members, except for the cropping calendar which is still being studied by the IA. The IA also has a revolving fund which it uses to assist members in the procurement of farm inputs. The IA, however, has not acquired water permit.

2) Codingle CIS

a) Technical - The system needs major repairs on its dam, canal structures and canal lines. It is scheduled for rehabilitation within 1988. Seepages along the system's canal lines were most evident.

b) Institutional - The irrigators' association has no record nor document being maintained. It likewise has no system management plans. Farmers alleged that since the system's original construction in 1975, it was only sometime in June, 1988, that the system was able to partially operate. The system was rehabilitated in 1984, and was then, temporarily turned over to the irrigators' association.

3) Sta. Rita CIS

a) Technical - From its original construction design whereby the system was served by a main diversion dam, the system presently utilizes a series of three check structures, constructed along the same creek per rehabilitation in 1987. Because of this, most of the system's original facilities had been abandoned. The original main dam, in particular, presently serves an area of only 10-20 hectares (ha) from the original design area of more than 100 ha.

b) Institutional - The IA has no record or documents being maintained. Likewise, it has no system management plans. IA members and officers had been observed to be inactive. After rehabilitation of the system in 1987 management was not turned over to farmers. Farmers alleged that the said rehabilitation was not yet completed.

4) San Roque CIS

a) Technical - The system was observed to be fully operational and well maintained. It has a concrete-lined main canal and lateral canal. No notable defect of the system was observed.

b) Institutional - The association has incomplete records. It has no water permit and has not yet registered with the SEC. The IA also has no system management plan. The operation and management of the system was observed to be solely handled by the IA President. Other IA officers had no evident involvement in the management of the system.

5) Alipasyawan CIS

a) Technical - The system is scheduled for rehabilitation in 1988. Two major technical concerns were identified. The first and foremost was the diversion dam which need strengthening of the left guidebank and the second was regarding the main canal railroad crossing structure which need restoration/modification in order for the system to generate its designed area.

b) Institutional - The IA has no water permit and has incomplete financial records. It has system management plans but these plans had not been widely observed by the members. Officers cite the non-operational railroad crossing structure as the major cause for deviations in the implementation of their system management plans. There is a need to firm-up membership of the association upon repair of the railroad crossing structure or even before the scheduled rehabilitation of the system.

6) Nagba CIS

a) Technical - The system is scheduled for rehabilitation in 1988. Aside from repair and improvement of the system's facilities, desilting of canal and repair of structures, there is a need to construct drainage canal in order to drain excess water run-off.

b) Institutional - The IA has no SEC registration and water permit. It likewise has incomplete organizational and financial records. The IA has system management plans which are being implemented by officers and members. Membership of the association need to be firmed-up considering that less than half of its potential members are registered with the IA.

7) Malonoy CIS

a) Technical - The system had just been rehabilitated and there are still additional works being undertaken. The diversion dam of the system need to be provided with a protection dike along the right upstream embankment.

b) Institutional - A partial turn-over for the 1987 rehabilitation had been facilitated. The IA, however, has no water permit and has incomplete financial records. It likewise, has no system management plans. An additional 10 has, irrigable area may be generated upon completion of ongoing additional rehabilitation works. This area comprise sector V of the system.

8) Ilas CIS

a) Technical - The system is presently still undergoing minor rehabilitation and extension works. Lateral A canal of the system had been temporarily abandoned due to alleged right-of-way problems. These problems are presently being negotiated by the association. Although generally operational, some portions of the system's facilities need minor repair, such as raising of canal embankments, desilting and clearing.

b) Institutional - Although the 1983 rehabilitation of the system was already turned-over, its original construction in 1981, as alleged was not accepted by the farmers. The IA has no water permit, no cropping calendar and has incomplete financial records. However, it has a system management plan which is being adhered to by the members.

9) Mianay CIS

a) Technical - Some facilities and structures of the system had deteriorated causing reduction in its irrigable area. The canal lines are susceptible to seepage due to soil type and therefore need concrete lining. A closed conduit at Sta. 0+800-0=902, has a relatively small diameter posing problems in maintenance/desilting.

b) Institutional - The IA is not yet registered with the SEC and does not possess a water permit. The IA has incomplete organizational and financial records. It likewise has no system management plans.

10) Sinabsaban CIS

a) Technical - The system had just been rehabilitated in 1986-87. Although, generally operational, the system's facilities and structures were observed to be not well maintained. Some canal structures had already deteriorated. Some thresher crossings had also been constructed without inlet and outlet transitions and collars.

b) Institutional - The association is not registered with the SEC and has no water permit. The IA has no financial records and has an incomplete organizational records. It likewise has no system management plans formulated.

11) Quiasan CIS

a) Technical - The system was observed to have severely deteriorated and requires rehabilitation. Most of its structures are still operational.

b) Institutional - The IA of the system had been observed to be inactive. Only the IA President exercises his functions and has also assumed the functions of the other IA officers. The IA started to become inactive since 1983, when the ICO of the system was pulled out. The IA President maintains a limited number of records and documents of the association but these were not properly classified and organized.

12) Jolongahog CIS

a) Technical - The system had just been rehabilitated in 1987. Generally, the whole system is operational and well maintained except for the steel gate stem which was cut-off thereby curtailing control of water diversion.

b) Institutional - The IA is registered with the SEC, but has no water permit. The IA is generally active, but has not yet accomplished its financial records. It has a system management plan, but no cropping calendar.

13) Bating CIS

a) Technical - The system is non-operational due to insufficient water supply and low dam crest elevation, making it difficult to divert water to the irrigable area.

b) Institutional - There is no existing IA. The system was not able to operate since its completion in 1978.

14) Balucuan CIS

a) Technical - The system was rehabilitated in 1987. Although generally operational, some structures of the system were not yet completed. A portion of the main canal which was designed with concrete lining has not been finished. Only the flooring with side bars had been completed. Some thresher crossings have no inlet, outlet and collar.

b) Institutional - The IA is not registered with the SEC, and does not possess a water permit. Organizational records of the IA are incomplete and no financial records/documents are available. The IA has, however, system maanagement plans formulated which are implemented at varying levels. The IA has an impending organizational problem regarding the turn-over of documents from the old to the newly elected officers. Several issues regarding the rehabilitation of the project in 1987 were also manifested.

15) Cala-agus CIS

a) Technical - The system had been observed to be operational and well maintained. Portions of the main canal is proposed for concrete lining due to inherent seepage as most of these canal lines traverse side hills.

b) Institutional- The IA is not yet registered with SEC and has no water permit. IA organizational and financial records, although incomplete, are fairly maintained and organized. The IA also has a system management plan which is strictly implemented and observed by the members.

16) Malocloc CIS

a) Technical - The system has a well maintained network of canal and canal structures. The downstream, tailend facilities of the system that include 6 thresher crossings are, however, abandoned due to right-of-way problems.

b) Institutional - The IA is not registered with the SEC and has no water permit. Although, members and officers alleged that their IA has the certificate of registration, this was however, not available for perusal during the inventory. IA records and documents were with the IA President and these were not turned over to the IA when the said President left for abroad. The IA has system management plans which are strictly implemented and followed by the members.

17) Ivisan-Ilaya CIS

a) Technical- The system was observed to be generally operational except for a deficiency in the dam. Water usually overtops the guide bank of the diversion dam.

b) Institutional - The IA has no SEC registration and water permit. Its organizational records are in order, but has no financial records. The IA also has system management plans for cropping calendar and maintenance, but does not have water distribution scheme/plan except that water delivery is on a first come first served policy.

18) Maninang CIS

a) Technical - The system is still operational, but not effectively utilized due to inadequate water supply. The canal lines were already obliterated.

b) Institutional - No IA exist in the system.

19) Dapdapan CIS

a) Technical - The system was generally operational, although several structures were found defective. The diversion dam has sustained significant damage.

b) Institutional - The association is registered with the SEC, but has no water permit. Organizational records of the association are in order but it does not have financial records and documents. The IA, however, possess the standard Financial Management System (FMS) books and formats. The IA has no system management plans. The IA was able to raise more than 30% in equity during the recent rehabilitation of the system and is therefore exempted from amortization payment.

20) Dinginan CIS

a) Technical - The system was noted to be totally non-operational. Canal lines were already converted to rice paddies and the canal structures had been abandoned.

b) Institutional - No information was gathered since there is no existing IA.

21) San Jose-Humaguichic CIS

a) Technical - The dam was noted to be operational, but was not being utilized due to inadequate water supply.

22) Taslan CIS

a) Technical - The system is totally non-operational. Canal lines were converted to rice paddies and the canal structures could no longer be located.

b) Institutional - There is no existing IA.

Appendix A. Inventory of existing CIS

Name of CIS ________________ Date of Inventory ________

Municipality ________________ Conducted by ____________

Province ________________

I. TECHNICAL :

1. Area Coverage :

Barangays covered : ____________ ________________

____________ ________________

____________ ________________

Design Area : ____________ has

Service Area based on dependable water

supply (has): WS_____ DS_____

1987 Irrigated Area : WS______has DS________has

Water Source : a) Main ________________________________

b) Supplementary ________________________

2. Diversion :

Type of Diversion : Dam ____________ Intake ___________

If dam : height ___________________ Length ___________

Crest shape : Trapezoidal __________ Ogee ___________

Sluicegate : Steel gate ____________ Flush board _______

Steel gate condition : Operational __ Non-operational ___

Steel Headgate : Provided __________ None ____________

Steel gate condition : Operational __ Non-operational ___

Condition of dam sections:

APRON : Upstream __________________

Downstream _________________

Guidebanks : Left upstream ____________

Right upstream ____________

Left downstream ____________

Right downstream __________

Boulder Riprap :

Left D/S Guide Bank ________

Right D/S Guide Bank _______

D/S apron _________________

Over-all condition of the dam : (Give comments and recommenda

____

____

____

3. Canal Structure :

STATIONING	KIND OF STRUCTURES	CONDITION			REMARKS
		OPERA-TIONAL	NEEDS REPAIR	ABAN-DONED	

Comments/recommendations on the over-all condition of canal Structures

____

____

____

____

____

4. Canal Network:

L E N G T H/S T A T I O N I N G

	OPERATIONAL	NEEDS REPAIR	ABAN-DONED	REMARKS
Main Canal				
Lateral				
Main Farm Ditch				
Supplementary Farm Ditch				
Drainage Ditch				

Comments/Recommendations on the over-all condition of the canal network

____

____

____

5. Others

Water diverted at headgate during inventory ______ lps
Predominant soil type within the service area :

Upstream ____________
Midstream ____________
Downstream ____________

Crops planted during

	WET SEASON	DRY SEASON
Upstream		
Midstream		
Downstream		

Average Yield (cav/ha) WS ________

DS ________

Other crops that maybe planted :

____

____

Other facilities needed to improve irrigation efficiency within the presently irrigated area :

____

____

____

Possible extension area ______________has

Facilities needed

Farm to market road ________kms.

Post harvest facilities: Bodega ____Drier____

Thresher __________

Others (Specify) :

____

____

____

List of respondents :

	Name	Position
1.	____________________	____________________
2.	____________________	____________________
3.	____________________	____________________
4.	____________________	____________________
5.	____________________	____________________

II. INSTITUTIONAL :

A. Organizational Management

1. Name of Irrigators Association : ______________
2. Date first organized and agency responsible ______
____
3. Registration No. and date registered
   (indicate whether SEC or FSDC) : ______________

4. Water Permit No. and date acquired : __________
____
5. Date system turned over to IA :

   Original Construction ______________
   First Rehabilitation ______________
   Second Rehabilitation ______________
   Others (Specify) ______________

6. No. of potential beneficiaries : ______________
7. No of registered IA members: ______________
8. No. of members benefitted :

Year	Wet Season	Dry Season
1986	______	______
1987	______	______

9. No. of additional potential members : __________
10. IA Plan / Action regarding additional potential members : ______________
____

11. IA Officers :

No. of IA Officers	Title or Position	Manner of Acquiring Position	Renumeration
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______

12. IA Election conducted :

   Annually _____ Bi-annually _____ Others _______

13. Date last election held : ______________
14. % attendance during election : ______________

15. IA meetings :

Kind of Meeting	Frequency	% attendance	Date last Conducted	Remarks
______	______	______	______	______
______	______	______	______	______
______	______	______	______	______
______	______	______	______	______

16. Existing O & M Committees :

____

____

17. IA Organizational Records :

SEC Registration ________

By - Laws ________

Water Permit ________

Minutes of Meetings ________

Log Book ________

Resolutions ________

Communications/Correspondence________

Paddy map ________

Area on Paddy Map ________

Others (Specify) ________

B. System Management

1. No. of sectors within the system : ______________

2. Cropping Calendar

a. Cropping Calendar prepared : Yes ____ No ______

b. % adherence to cropping calendar : ____________

c. Persons responsible in the implementation and monitoring of cropping calendar :

Position	Duties and Responsibilities	Remuneration
________	____________	____________
________	____________	____________

d. Problems encountered in the implementation of Cropping Calendar :

____
____
____
____

e. Other observations :

3. WATER DISTRIBUTION

a. Water Distribution plan prepared : Yes ___ No ___

b. Water distribution scheme :

(1) Normal Water Distribution scheme : _________

____

(2) Water Crisis Distribution Scheme : _________

____

c. No. of Rotational Units : ____________________

d. % adherence to water distribution plan : ______

e. Persons responsible in the implementation and monitoring of water distribution plan :

Position	Duties and Responsibilities	Remuneration
________	___________	___________
________	___________	___________
________	___________	___________

f. Problems encountered in the implementation of Water Distribution Plan :

____
____
____

g. Other observations :

4. SYSTEM MAINTENANCE

a. System Maintenance Plan formulated : Yes__ No___

b. System Maintenance scheme :

(1) System Level ______________________________

____

(2) Sector Level : ____________________________

____

c. % adherence to system maintenance plan : _____

____

d. Persons responsible in the implementation and monitoring of system maintenance plan :

Position	Portion of the system	Duties and Responsibilities	Remuneration
________	________	________	________
________	________	________	________

e. Problems encountered in the implementation of system maintenance plan

____

____

f. Other observations :

C. FINANCIAL MANAGEMENT

1. Collection VS Expenses :

IA Income			IA Expenses	
Source of Income	Amount(P)	:	Type of Expenditures	Amount (P)
________	________	:	________	________
________	________	:	________	________
________	________	:	________	________
________	________	:	________	________
TOTAL . . . .P		:	TOTAL . . . P	

2. IA Membership Fee : ______________________

3. IA Annual Dues : ______________________

4. IA Financial Records

a) Official Receipt ______

b) Cash Voucher ______

c) Membership Index Card ______

d) Water Service Bill ______

e) Water Service Invoice ______

f) Collector's Remittance Form ______

g) List of Unpaid Accounts ______

h) Cash Book ______

i) Journal Ledger ______

j) Cash Statement ______

k) IA Budget ______

l) Others (Specify) ______

5. Persons responsible in the collection of Dues/Fees:

Position	Duties and Responsibilities	Remuneration
______	______	______
______	______	______
______	______	______

6. Trainings

Type of Training	Conducted By	Date Conducted	No. of Participants
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______

7. Existing Inter-agency Programs Availed by IA :

Name of Agency	Type of Program
____________________	____________________
____________________	____________________
____________________	____________________

8. Frequency of NIA Personnel Visitation :

PIE / Asst. PIE ____________________

ICO / IOW ____________________

IT ____________________

Others (Specify) ____________________

9. Other observations :

Appendix B. Inventory of team members

NAME	POSITION/DESIGNATION/STATION
A. Technical Team	
1) Leonardo A. Palteng	Engineer B, Communal Irrigation Development Project (CIDP), NIA, Central Office (CO)
2) Thelma B. Mallorca	Engineer B, NIA, Region VI
3) Ronnie B. Jagorin	Engineering Assistant B, NIA, Region VI
4) Tomas L. Ticao	Engineeer B, Capiz PIO
B. Institutional Team	
1) Thelma C. Salle	Farmers' Training Officer CIDP, NIA, CO
2) Noralyn C. Abilay	Irrigators Organization Worker CIDP, NIA, CO
3) Dionisio B. Giron	Irrigators Association Worker NIA, Region VI
4) Gadel Amir B. Dianala	Profile Writer, NIA, Region VI
5) Alberto A. Lopez	Irrigation Community Organizer Capiz PIO
C. Supervisors/Facilitators	
1) Rudy R. Ibabao	Supervising Engineer B NIA, Region VI
2) Ricardo B. Fernandez	Supervising Irrigators Association Worker, NIA, Region VI
3) Rodrigo C. Solidarios	Provincial Irrigation Engineer Capiz PIO

Appendix C. Schedule of inventory field work

DAY	DATE	CIS VISITED/MUNICIPALITY
01 -	June 17	a) Salcedo CIS, Dumarao
02 -	June 20	a) Codingle CIS, Dumaro
03 -	June 21	a) Sta. Rita CIS, Dumalag b) San Roque CIS, Dumalag
04 -	June 22	a) Alipasyawan CIS, Dumaro b) Nagba CIS, Cuartero c) Malonoy CIS, Dao
05 -	June 23	a) Ilas CIS, Cuartero b) Mianay CIS, Sigma
06 -	June 24	a) Sinabsaban CIS, Ma-ayon b) Quiasan CIS, Pontevedra c) Jolongahog CIS, Pontevedra
07 -	June 25	a) Bating CIS, Mambusao b) Balucuan CIS, Sigma c) Cala-agus CIS, Mambusao
08 -	June 26	a) Malocloc CIS, Ivisan b) Ivisan-Ilaya CIS, Ivisan
09 -	June 27	a) Maninang CIS, Sapi-an b) Dapdapan CIS, Sapi-an c) Dinginan CIS, Roxas City d) San Jose-Humaguichic CIS, Roxas City
10 -	June 28	a) Taslan CIS, Dumarao

Appendix D. Chronology of inventory activities

June 17, 1988

0745H - Departure from Capiz PIO for Salcedo CIS
0830H - Arrival at Salcedo CIS. Sr. ICO and IA Officers were waiting at the house of IA President
1015H - Start of Technical Walkthrough and Institutional interview
1125H - End of Technical Walkthrough
1230H - End of Institutional interview
1400H - Left Salcedo CIS for Capiz PIO
1440H - Arrived at Capiz PIO

June 20, 1988

1250H - Arrived Codingle CIS from RIO
1255H - Start of Institutional interview
1400H - Start of Technical walkthrough
1435H - End of Institutional interview
1600H - End of Technical walkthrough
1640H - Arrived Capiz PIO
2040H - Wrap-up and discussion of findings/observations

June 21, 1988

0630H - Left Capiz PIO for Sta. Rita CIS
0830H - Arrived Sta. Rita CIS
0925H - Start of Technical walkthrough and Institutional interview
1055H - End of Technical walkthrough
1140H - End of Institutional interview
1225H - Left for San Roque CIS
1238H - Arrive San Roque CIS
1255H - Start of Technical walkthrough
1408H - End of walkthrough
1420H - Left San Roque CIS for IA President's house at Dumalag poblacion
1440H - Arrive at IA Presidents house. Start of Insitutional interview
1505H - End of interview
1510H - Left for Capiz PIO
1650H - Arrived Capiz PIO
1700H - Wrap-up and collation of data on pumps and systems already surveyed

June 22, 1988

0730H - Left Capiz PIO for Alipasyawan CIS
0840H - Arrived Alipasyawan CIS
0900H - Start of interview and walkthrough
1040H - End of interview
1055H - End of walkthrough
1058H - Left for Nagba CIS
1235H - Arrived Nagba CIS - at IA President's house
1315H - Start of walkthrough. Technical team split into two groups
1440H - End of walkthrough
1455H - End of interview
1500H - Left for Malonoy CIS
1525H - Arrived Malonoy CIS
1535H - Start of walkthrough and interview
1640H - End of walkthrough
1650H - End of interview
1700H - Left Malonoy CIS for PIO
1735H - Arrived Capiz PIO
1930H - Wrap-up and discussion of survey results and observations

June 23, 1988

0730H - Left PIO for Ilas CIS
0900H - Arrived Ilas CIS
0925H - Start of interview
0940H - Start of walkthrough
1200H - End of Technical walkthrough and interview
1240H - Left for Mianay CIS
1410H - Arrived Mianay CIS
1430H- Start of walkthrough and interview
1520H - End of walkthrough. Downstream portion not inspected due to heavy rain
1600H - End of interview
1605H - Left Mianay CIS
1645H - Arrived Capiz PIO
1840H - Wrap-up and collation of data

June 24, 1988

0735H - Left PIO for Sinabsaban CIS
0910H - Arrived Sinabsaban CIS
0930H - Start of walkthrough
1010H - Start of interview
1135H - End of walkthrough
1140H - End of interview
1230H - Left for Quiasan CIS
1332H - Arrived Quiasan CIS
1353H - Start of walkthrough and interview
1510H - End of walkthrough
1515H - End of interview. Left for Jolongahog CIS

June 24, 1988 (cont.)

1525H - Arrived Jolongahog CIS
1530H - Start of walkthrough and interview
1640H - End of interview
1645H - End of walkthrough. Left for Capiz PIO
1810H - Arrived Capiz PIO
2100H - Wrap-up and collation of data

June 25, 1988

0750H - Left for Bating CIS
0815H - Arrived Bating CIS, conducted walkthrough,no interview since their is no IA
0840H - Left for Capiz PIO
0857H - Back to Capiz PIO
0905H - Left for Balucuan CIS
0940H - Arrived Balucuan CIS
0950H - Start of walkthrough and interview
1200H - End of interview
1210H - End of walkthrough
1215H - Left for Capiz PIO
1245H - Arrived Capiz PIO
1335H - Left for Cala-agus CIS
1405H - Arrived Cala-agus CIS
1410H - Start of interview
1457H - Start of walkthrough
1600H - End of interview
1750H - End of walkthrough
1755H - Left for PIO
1835H - Arrived Capiz PIO

June 26, 1988

0850H - Left for Malocloc CIS
0935H - Arrived Malocloc CIS
0943H - Start of Technical walkthrough
0952H - Start of interview
1040H - End of walkthrough
1100H - End of interview
1105H - Left Malocloc CIS for Ivisan-Ilaya CIS
1110H - Arrived at Ivisan-Ilaya CIS
1113H - Start of interview
1154H - End of interview
1230H - Start of walkthrough
1323H - End of walkthrough, left for Capiz PIO
1900H - Arrived Capiz PIO

June 27, 1988

0755H - Left for Maninang CIS
0825H - Arrive Maninang CIS, conducted walkthrough, no interview was undertaken due to non-existent IA
0850H - Left Maninang CIS
0925H - Arrived Dapdapan CIS
0935H - Start of interview
1045H - Start of Walkthrough
1055H - End of interview
1220H - End of walkthrough
1327H - Left Dapdapan CIS
1343H - Institutional Team dropped at Ivisan-Ilaya CIS, while Technical Team proceeded to Roxas City
1407H - Arrive Dinginan CIS. Conducted walkthrough
1430H - Left for San Jose-Humaguichic CIS
1450H - Arrive San Jose-Humaguichic CIS, conducted walkthrough
1500H - Left for Capiz PIO
1645H - Back to Capiz PIO
1740H - Wrap-up and finalization of accomplished questionnaire

June 28,1988

0745H - Finalization and tabulation of data gathered for CIS and pump systems
0955H - Left Capiz PIO for Taslan CIS, conducted walkthrough and interview with Barangay Captain
1105H - Left Taslan CIS and proceeded to RIO
1320H - Arrive RIO and continued finalization of accomplished questionnaire

June 29, 1988

0930H - Wrap-up re-accomplishment of Inventory Team

Appendix E. Inventory time per project

NAME OF SYSTEM	STATUS	SERVICE AREA (HA)	INVENTORY TIME INSTITUTIONAL	TECHNICAL
1) Salcedo CIS	Operational	123.0*	2 hrs. 15 min.	1 hr. 30 min.
2) Codingle CIS	Operational	45.0	35 min.	2 hrs.
3) Sta. Rita CIS	Operational	38.37*	1 hr. 55 min.	1 hr. 30 min.
4) San Roque CIS	Operational	60.0	25 min.	1 hr. 13 min.
5) Alipasyawan CIS	Operational	70.0	1 hr. 40 min.	1 hr. 55 min.
6) Nagba CIS	Operational	145.0*	1 hr. 40 min.	1 hr. 25 min.
7) Malonoy CIS	Operational	73.39*	1 hr. 15 min.	1 hr. 5 min.
8) Ilas CIS	Operational	495.5*	2 hrs. 35 min.	2 hrs. 20 min.
9) Mianay CIS	Operational	16.82*	1 hr. 30 min.	50 min.
10) Sinabsaban CIS	Operational	92.29*	1 hr. 30 min.	2 hrs. 5 min.
11) Quiasan CIS	Operational	48.27*	1 hr. 22 min.	1 hr. 17 min.
12) Jolongahaog CIS	Operational	45.35*	1 hr. 10 min.	1 hr. 15 min.
13) Bating CIS	Non-operational	70.0		25 min.
14) Balucuan CIS	Operational	140.0	2 hrs. 10 min.	2 hrs 20min.
15) Cala-agus CIS	Operational	43.69*	1 hr. 50 min.	2 hrs. 53 min.
16) Malocloc CIS	Operational	30.31*	1 hr. 8 min.	57 min.
17) Ivisan-Ilaya CIS	Operational	43.15*	41 min.	53 min.
18) Maninang CIS	Non-Operational	60.00		25 min.
19) Dapdapan CIS	Operational	70.0	1 hr. 20 min.	1 hr. 35 min.
20) Dinginan CIS	Non-operational	125.0		23 min.
21) San Jose-Humaguichic CIS	Non-Operational	100.0		10 min.
22) Taslan CIS	Non-operational	70.0		25 min.

* - Based on paddy map

Developing a Management Information System for Farmer-managed Irrigation Systems in the Philippines

A Case Study

B. de Lima[9]*, R. Gamboa*[10] *and B. Bagadion*[11]

INTRODUCTION

An on-going action research in the National Irrigation Administration (NIA) of the Philippines is developing a process for building capacity in farmer-managed irrigation systems (FMIS) for increasing production and income through the integration of management of water and management support services (i.e., credit mobilization and utilization, supply of agricultural inputs and marketing of production). The work includes developing a management information system (MIS) for: 1) monitoring day-to-day operations of the FMIS to facilitate weekly evaluation needed for improving operations within a cropping season and 2) for use by the irrigation associations (IAs) that own and manage the systems and by the NIA, for evaluating progress from season to season. This paper deals with the development of the MIS and the lessons being learned.

The MIS is developed with the objective of increasing production and income of the IA and its members through the following activities: 1) further strengthening IA viability, 2) members' credit mobilization and utilization, 3) procurement and distribution of agricultural inputs, 4) marketing production, 5) capital build-up (CBU) from members and 6) farm management take over (FMTO) by the IA from members who fail to pay their loans on time. These activities were identified by the IA with NIA assistance in a series of workshops. Policies, rules, regulations and expanded organizational arrangements for carrying out these activites were framed by the IA members and ratified by the General Assembly.

For the MIS, a benchmark survey was conducted to gather data on the level of farmer organization, water control, cropping practices, use of inputs, level of inputs and outputs and level of agricultural income. The benchmark survey was intended to serve as the baseline upon which to measure progress of the FMIS from season to season.

For monitoring and evaluating daily and weekly activities so that improvement in operations can be undertaken during a cropping season, an irrigation association management information system (IAMIS) has been installed covering both management of water and management of support services.

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Among the lessons being learned in the action research activity are: 1) if properly trained IAs can go into management of support services in addition to management of water. An MIS suited for this purpose has to be installed. 2) The MIS program for this purpose should be simple and responsive to the activities of the IA, 3) much depends on the skills of NIA staff for providing training and guidance to the IAs for installing the appropriate MIS, and 4) development of financial management procedures suited to the IAs is crucial to MIS implementation.

The most recent action research in the National Irrigation Administration (NIA) for further strengthening farmer-managed irrigation systems (FMIS) in the Philippines is in two pilot projects in the province of Camarines Sur. The objective of NIA in these two projects is to develop a process for building capacity in FMIS for increasing production and income through the integration of the management of water and the management of support services. Within the scope of support services are credit mobilization and utilization, supply of agricultural inputs and marketing of production. In the management of water and support services, and their integration, a management information system (MIS) is being developed as a tool of the FMIS in attaining its goals and as a means for evaluating the pilot projects. This paper deals with the on-going development of the MIS. The development process has two parts. One part is for use primarily as a tool for monitoring day to day operations of the FMIS and a weekly evaluation for guiding improvement of operations within a cropping season. The other part is for use of the irrigation association (IA) that owns and manages the system, and of the NIA, for evaluating progress from season to season.

The two pilot projects are the Aslong Communal Irrigation System (Aslong CIS) and the Gatbo Communal Irrigation System (Gatbo CIS), both are run-of-the-river gravity irrigation systems in Camarines Sur. Aslong CIS is owned and managed by the San Isidro-Bahay-Aslong-Palangon Irrigator's Association (SIBAP IA) which has 152 members. Gatbo CIS is owned and managed by the May Acacia Irrigator's Associations (May Acacia IA) composed of 115 members. Both IAs are legal entities, duly registered with the government, with power to enter into contracts and transact business with the government and other entities. Both have water rights grants from the government. Their irrigation systems were originally built by the farmers and subsequently improved and expanded by NIA with participation of the farmers in planning and construction. Each has a Board of Directors (BOD) elected annually by the members as the governing body responsible to the General Assembly of members. The two IAs have similar organizational structures, a diagram of which is in Annex 1.

As shown in the organization diagram the two main services to the farmers are the irrigation service and the agribusiness service. The bases of the IAs are the sectors and *seldas* (small groups). Sectors are hydrologic units of the system based on the canal layouts, while seldas are groups of 10 to 15 farmers for facilitating management of support services. The President of the IA also serves as the Chairman of the BOD. Depending on their capacity and availability members of the BOD serve in other positions of the organization. The physical facilities and other organizational features of the two IAs are summarized in Table 1.

Table 1. Comparative characteristics of Aslong CIS and Gatbo CIS

ITEMS	ASLONG CIS	GATBO CIS
1. Normal irrigated area		
Wet season	205 hectares	152 hectares
Dry season	199 "	102 "
2. Average size of landholdings	1.1 "	1.0 hectare
3. Crops raised	Rice	Rice
4. Irrigation facilities		
Diversion works	concrete dam and headgate	six intake structures
Canals (earthen)	17.2 kilometers(km)	7.2 kilometers(Km)
Canal structures	concrete,20 units	concrete,10 units
5. Number of villages served	4	3
6. Construction cost	P1.308 million Pesos (P) (about US$93,500)	P981,449 (about $58,000)
7. Repayment period (without interest)	26 years	22 years
8. Irrigation fees paid by water users to IA	100 kilograms(kg) of paddy per crop	60 kilograms(kg) of paddy per crop
9. Water rights grant from government	500 liters/second throughout the year	104 liters/second throughout the year
10. Number of members in IA Board of Directors	11	13
11. Mode of selection of members of the BOD	Annual election by General Assembly	Annual election by General Assembly
12. Number of IA standing committees	6	6
13. Number of sectors	6	7
14. Number of seldas	19	15

For the longer term objective of increasing production and income of the FMIS on a sustainable basis, each of the two IAs have the following activities: 1) further strengthening of IA viability, 2) members' credit mobilization and utilization, 3) procurement and distribution of agricultural inputs, 4) marketing of production, 5) capital build-up (CBU) from members, 6) farm management take over (FMTO) by IA from members who fail to pay their loans on time. These activities were identified in workshops facilitated by NIA staff first at the BOD level and then in follow-up workshops at the sectors level. These workshops formulated the policies, rules and regulations to govern these new activities and also agreed on the new IA organizational structure for carrying out the activities. Subsequently these activities, their policies, rules and regulations and the new organizational structure were ratified in the General Assembly meeting of each IA and authorized for implementation. These preparations, from the time NIA initiated proposals with the BODs until ratification by their General Assemblies took about four months for the Gatbo CIS and five months for the Aslong CIS.

PROCEDURES FOR DEVELOPING THE MIS AND SOME OBSERVATIONS ON RESULTS

The implementation of the activities approved by the General Assemblies necessitated the installation of management information systems. The first activity for this was a benchmark survey for the two pilot projects. The objective was to gather data on the level of farmers organization, water control, cropping practices, use of inputs, level of inputs and outputs and level of agricultural income. For the survey two sets of questionnaires were used: 1) benchmark survey form for farm households and 2) benchmark survey for IA. For the farm households survey random sampling was conducted in the two pilots resulting in 32 sample farmers (13% of the members) in Aslong CIS and 30 sample farmers (20% of the members) in Gatbo CIS. Analysis of the results of the benchmark survey for farm households was limited to tabulation, comparison and simple interpretation of results. For the benchmark surveys of the IAs the vice president of Aslong CIS and the president of Gatbo CIS were interviewed by NIA staff.

The farm households survey covered the following aspects, among other things:

- Farmers profile, including tenurial status, educational attainment, farm size, years in farming, number of children, age, sex, etc.
- Credit financing and uses of credit
- Seeds, fertilizer, pesticides and labor utilization
- Water-related farm characteristics
- Farmers farm practices
- Farm area and production
- Participation of members in the IA and membership in other community organizations
- Post harvest activities; volume of (paddy) sold and average selling prices of paddy for wet season and dry season.
- Cost and return analysis for rice production in wet season and dry season
- Family income from other sources
- Annual family cash flow

The benchmark survey was conducted in Aslong CIS during April 2 to 19, 1991 and in Gatbo CIS from April 23 to May 2, 1991 by two interviewers each. Attached are Annex 2, the questionnaire for the farm households survey, and Annex 3, the questionnaire for the IA survey. For illustrative purposes sample results of the benchmark farm management survey are shown in Table 2:

Table 2. Sample results of Benchmark Farm Management Survey

PARAMETERS	Aslong, 1990 (Yr.) n = 32 Wet Season	Aslong, 1990 (Yr.) n = 32 Dry Season	Gatbo, 1990 (Yr.) n = 30 Wet Season	Gatbo, 1990 (Yr.) n = 30 Dry Season
Credit Financing				
No. of farmers with loans	11	8	14	7
Total amount of loans	P 35,300 ($ 1,412)	P 39,300 ($ 1,572)	P 46,900 ($ 1,876)	P 39,400 ($ 1,576)
Average loan per hectare	P 3,086 ($123.44)	P 2,212 ($ 88.48)	P 2,593 ($ 103.72)	P 2,195 ($ 87.80)
Fertilizer Utilization				
Area planted in hectares (ha)	35.96	35.96	30.72	30.72
Total fertilizer applied (bags of 50 kg. each)	85.8	87.8	118.5	119.5
Average application per ha (bags per ha)	2.39	2.44	3.86	3.89
Average production, kilograms (kg.) per ha	2,244	2,364	3,086	2,344
Average selling price of palay in pesos (P) per kg.	P 4.03 ($ 0.16)	P 4.04 ($ 0.16)	P 4.29 ($ 0.17)	P 4.48 ($ 0.18)
Net returns per hectare	P 2,140 ($ 85.60)	P 2,907 ($ 116.28)	P 5,504 ($ 220.16)	P 3,197 ($ 127.88)

The benchmark survey was for establishing a baseline upon which to measure progress towards the objectives of the IA. After the projects begin to generate effects after one or more cropping seasons new information on the same parameters would be gathered and compared with the baseline information. The change indicated by the comparison would be the measure of project progress. As of the preparation of this paper the follow-up surveys have started but are not yet complete. Obviously, this MIS procedure is useful only for comparing results of one season with those of another. Moreover, it does not promote self-reliance of IAs as data gathering is undertaken by NIA staff. However, the information it generates is useful for NIA operations and for longer term impact evaluation of the IA and its irrigation system.

The other part of the MIS being developed in the two pilot projects is one which is undertaken by the IA and is useful for monitoring and evaluation of on-going activities so that corrections or improvements in operations can be immediately undertaken by the IA within the cropping season. It covers the two principal services of the IA: *irrigation service and agribusiness service*. As in their preparatory planning workshops both IAs identified the strengthening of viability as their first objective, a monitoring and evaluation system was installed for areas irrigated, farming operations, production and irrigation service fees collection. For this purpose, NIA staff included the two pilot projects among several where an improved irrigation association management information system (IAMIS) was to be implemented on a trial basis. NIA staff prepared the procedures for this and guided both IAs in installing IAMIS as part of IA operations.

IAMIS prescribes a procedure for weekly monitoring of farming activities in every lot, and water supplied in every sector, so that at the end of the week information is available on area irrigated and status of farming activities in each sector and the whole system. This information becomes the basis for decisions on water distribution during the following week. IAMIS also prescribes a reporting procedure for area benefitted by the system, production of each irrigated lot, payment of irrigation fees by each farmer and seasonal financial and maintenance performance of the IA. The basic monitoring form is IAMIS Form 1 attached herewith as Annex 4. It is accomplished for every sector by the water tender or sector leader. Every week information gathered in IAMIS Form 1 is transmitted to the O & M manager of the IA who consolidates the information in IAMIS Form 1-A, (attached herewith as Annex 5) and uses it for deciding on changes in water distribution for the following week. It is also used by the agribusiness manager for scheduling releases of credit financing and agricultural inputs. At the end of the season Forms 1 and 1-A are completed and a seasonal performance assessment report is prepared using IAMIS Form 2, attached as Annex 6. Copies of these reports are made available to the Provincial Irrigation Office of NIA through an institutional development officer (IDO) or an irrigation technician that visits the IA.

In the two pilot projects IAMIS has been expanded to cover management of support services (agribusiness operations). Procedures have been added for monitoring acquisition and distribution of credit, fertilizers, agrochemicals, repayment of loans, marketing and financial transactions. Presently, financial recording uses single entry bookkeeping, but a manual has been completed for training IAs in double entry bookkeeping.

The installation of IAMIS in each IA involved the following steps:

1) The NIA IDO attended a meeting of the IA BOD and gave an overview of IAMIS and how it may help in attaining and strengthening IA viability. Agreement was reached on the training of the IA, the date and venue of the training and the participants which included the BOD, all sector leaders, and other IA members concerned with management activities of the IA.

2) A four-day live-in seminar was held facilitated by NIA staff previously trained in this work. Two days were devoted to lectures, discussions and workshops for understanding the rationale, content and procedures of IAMIS and the usage of the data gathered. The other two days were used for tutoring the IA officers, sector leaders, and water tenders on the gathering and recording of the information and the accomplishment and usage of Forms 1, 1A and 2. For the workshops the participants brought the parcellary maps of the system, and IA records such as list of members for each sector, cash book, used official receipts, collection of irrigation fees, cash vouchers, canal maintenance records, etc. The financial and maintenance records were used in determining the financial viability and canal maintenance efficiency in Form 2. Pending the installation of water measuring devices, filling up of information on actual water supply (AWS) in millimeters mm) per day was not undertaken during the workshops on Forms 1 and 1A. This parts of the forms still have to be simplified to suit farmer understanding and needs.

3) A seminar workshop was held on management and supervision of support services wherein procedures for monitoring credit mobilization and utilization, inputs acquisition and distribution, marketing, CBU and relevant financial matters were taken up. During this seminar workshop, the policies, rules and regulations for these activities were also agreed upon as the bases for developing the monitoring procedures.

4) Tutorial training was given by IDOs to IA staff recording and monitoring credit, agricultural inputs, palay (paddy) trading and cash receipts and disbursements.

5) Periodic follow-up by IDOs and irrigation technicians of NIA to check whether IAMIS activities of the IA were on a sustainable basis, provide further guidance as may be needed, and further improve IAMIS procedures.

Although the pilot IAs have been given training and follow-up guidance not all aspects of the expanded IAMIS are yet fully in place. The installation of water measuring devices have just been arranged in a way that calibrations of the gages will not only be in liters per second, but also in terms of hectares that can be irrigated during the dry season, in order that the gage readings can be interpreted and used more easily by the farmers. The agribusiness operations are just beginning and the initial volume so far does not yet warrant the full complement of staff envisioned in the IA agribusiness service. Moreover, the financial recording procedures using double entry bookkeeping still has to be installed. Nevertheless, some observations on the results of IAMIS indicate the following:

1) In Aslong CIS average production of paddy increased from 2.24 tons per hectare (benchmark survey) in the wet season of 1990 to 4.05 tons per hectare (IAMIS monitoring) in the wet season of 1991 and from 2.36 tons per hectare in the dry season of 1990 to 3.48 tons per hectare in the dry season of 1992. In Gatbo CIS average production of paddy decreased from 3.09 tons per hectare (benchmark survey) in the wet season of 1990 to 2.89 tons per hectare (IAMIS monitoring) in the wet season of 1991 but increased from 2.34 tons per hectare in the dry season of 1990 to 2.80 tons per hectare in the dry season of 1992.

2) Annual collection of irrigation fees as a percentage of annual payable increased in Aslong CIS from 48% in 1990 to 61% in 1991. In Gatbo CIS it was 55.2% in 1990 and 105% in 1991 including back accounts.

3) The average loan of farmers availing of credit in Aslong was P3,086 ($123.44) in the wet season of 1990 obtained from private money lenders with no farmer availing of credit financing from any bank. In the wet season of 1991, 35 farmers took loans out from the Land Bank of the Philippines averaging P6,013 ($240.50) per hectare on 30.86 hectares of land. In Gatbo CIS the average loan per hectare in the wet season of 1990 was P2,593 ($103.72) mostly from private money lenders. In the wet season of 1991, this increased to P6,502 ($260) per hectare for farmers that borrowed production loans from the Land Bank.

4) Average fertilizer use in Aslong CIS increased from 2.39 bags/ha for the wet season of 1990 to 2.94 bags/ha in the wet season of 1991. In Gatbo CIS it increased from 3.86 bags/ha in 1990 to 4.6 bags/ha in 1991.

5) As of mid-1992, capital build-up contributions from members in Aslong CIS was P8,136 ($325) and in Gatbo CIS it was P32,754 ($1,310). Effects on income still have to be ascertained by follow-up surveys along the lines of the benchmark survey.

6) The observed usage of IAMIS by the two IAs were generally along the following:

   a) Improvement of water distribution within the sectors. However, its potential for improving water distribution between sectors in times of water shortage has not yet been fully realized due to delays in consolidating the sectoral reports (Form 1) into the whole system report (Form 1-A). The delay emanates from the larger sectors that take a longer time for accomplishing Form 1. As an improvement, Form 1 will now be accomplished at the selda level. As there are only 10 to 15 members in a selda , accomplishment of the forms would be faster.

   b) Scheduling of the collection of irrigation fees.

   c) Scheduling of the distribution of agricultural inputs.

   d) Improvement of maintenance activities.

   e) Keeping close track of the cropping calendar, identification of problems of the system and initiating further improvements.

LESSONS LEARNED

Some lessons learned in the two pilot projects are as follows:

1) If properly trained IAs can go into management of support services in addition to management of water. For proper training, procedures for installing and operationalizing a suitable MIS should be included.

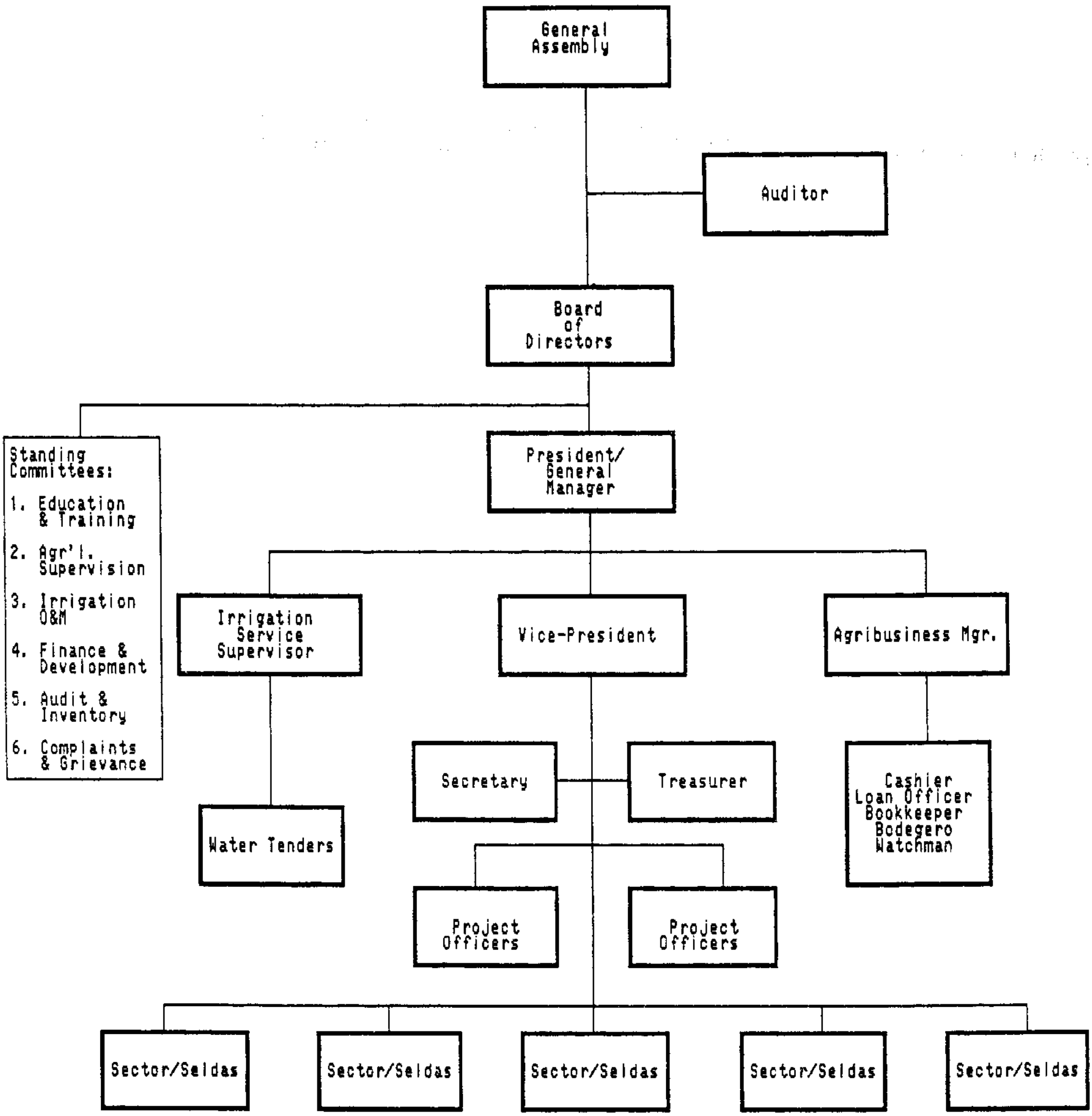
2) Management of support services and management of water when properly implemented tend to be synergistic, strengthening one tends also to strengthen the other. Engaging in management of support services in addition to management of water increases the motivation of the IA as it responds to the desire to have a whole program for increasing production and income. This motivation contributes to the adoption and implementation of an MIS program for the IA.

3) An MIS program for installation and implementation by an IA should be simple and responsive to the objectives of the IA. Before undertaking such installation, the objectives, programs and activities of the IA should be clearly defined and agreed upon by all members. Otherwise, implementation of the MIS, once installed, cannot be undertaken as members will not participate unless plans, programs and procedures are agreed upon in the General Assembly.

4) Much depends on the skills of NIA staff for providing training and guidance to the IAs in the planning and implementation of management of water and of support services, including their MIS. Such staff should be properly trained and motivated.

5) Development of financial management procedures suited to the operation of the IAs for management of water and of support services is crucial to the project and MIS implementation.

Annex 1. Organizational chart of Aslong CIS and Gatbo CIS



Annex 2. List of indicators coveres by farm households

Benchmark Survey For Aslong CIS and Gatbo CIS

1. Distribution of farmers by tenurial status
2. Distribution of farmers by number of years in farming
3. Distribution of farmers by age.
4. Distribution of farmers by farm size
5. Distribution of farmers by sex
6. Distribution of farmers by educational attainment
7. Farmers other occupation in addition to farming
8. Distribution of farmers by number of children
9. Educational attainment of children
10. Farmers source of agricultural credit for wet season and for dry season
11. Distribution of farmers by use of credit
12. Seed utilization, wet season and dry season
13. Pesticide utilization, wet season and dry season
14. Average labor utilization, wet season and dry season
15. Distribution of farmers by irrigation method, water sufficiency and water timeliness for both wet season and dry season
16. Distribution of farmers by method of seeding or transplanting, age of seedlings at transplanting and method of weeding in the wet season and in the dry season
17. Membership in community organizations
18. Members participation in irrigation association during planning, construction, operation and maintenance
19. Average farm size, total rice production in wet season and in dry season, average yield per hectare in wet season and in dry season
20. Farmers' post harvest practices, wet season and dry season
21. Farmers' market outlets, volume of palay sold and average selling price in wet season and in dry season
22. Distribution of farmers by materials used for residence
23. Distribution of farmers ownership of household appliances
24. Average family income from other sources in addition to farming, in wet season and in dry season
25. Average annual family living expenses of farmers broken down into various items such as food, education, medical care, clothing, transportation, etc.
26. Average cost and returns per hectare for rice production in wet season and in dry season
27. Average annual cash flow per farmer

Annex 3. Project benefit monitoring and evaluation benchmark survey

IA LEVEL

Name of Subproject ______________ Location ______________
Name of IA ______________ Seasons/Year ______________

Interviewee: ______________

I. AREA

1. Service area identified at Feasibility Study ________ ha.

2. Service area reported at final POW ________ ha.

3. Firmed up service area (not irrigable) ________ ha.

4. Programmed area to be irrigated this year

   a. Wet Season ________ ha.
   b. Dry Season ________ ha.

5. Actual area irrigated this year

   a. Wet Season ________ ha.
   b. Dry Season ________ ha.

6. Reasons if area actually irrigated is not equal to programmed area
   ____
   ____

7. Actual area planted this year

   a. Wet Season ________ ha.
   b. Dry Season ________ ha.

8. Reasons if area planted is not equal to area irrigated
   ____

II. WATER MANAGEMENT (In case of Rehab/restoration only)

1. a. At present, does the IA implement a cropping calendar)
   NO, why? ______________

   b. Were IA members trained to develop a cropping calendar?
   YES, By whom? ______________
   If through seminar, specify ______________

   c. Start of water delivery ______________

   d. Terminal Drainage ______________

   e. Did all farmers in the system follow the calendar?
   NO, only ________ %
   Why? ______________

   f. Problem encountered during implementation of cropping calendar. ______________
   ____

2. Water Distribution

a. What is the method of water distribution implemented in the system?

b. Is there a water distribution plan for the system?

c. If there is, are all farmers aware of this plan?

d. Who is In-charge of scheduling and implementing water distribution? ______________________________
____

3. Does the system experience water shortage during?

Wet Season? ________

Dry Season? ________

a. If yes, at what cropping stage DS ________________

b. Percent area affected DS ________________

4. Is there any drainage problem?

a. If yes, at what cropping stage? WS ________________

b. Percent area affected WS ________________

5. Was there any conflict in water distribution and water utilization among farmers?

III. PRODUCTION DATA

1. Lowest yield per hectare WS ________________ cav.
DS ________________ cav.

2. Highest yield per hectare WS ________________ cav.
DS ________________ cav.

3. Average yield per hectare WS ________________ cav.
DS ________________ cav.

4. How do you estimate the yield? ________________

5. Is the average yield higher or lower than the normal average yield in the system?

WS ______
DS ______

6. What factors are responsible for attaining higher yield?

1. Wet Season ________________
2. Dry Season ________________

IV. STATUS OF IA MANAGEMENT

1. Membership

a. Number of farmers benefitted or served by the system ______

b. Members of irrigators association ________________

Why are other farmers not members? ____________________

2. Composition of IA officials

Officer/Designation	Composition

3. IA Meetings

a. Meeting of BOD

Number of meetings this season ____________________

b. General Assembly Meeting

Number of meetings this season ____________________

4. Financial Management

a. Were you given financial management seminar?

b. Could you easily follow the procedures given to you?

c. Do you keep book of accounts for the IA?

d. What are the sources of IA funds ____________________

e. How much was the IA's budget this season? ____________________
Breakdown per activity, if any:

Activity	Budget
T O T A L	============================

f. Did you have enough funds for your budgetary requirements?

5. Irrigation Service Fee

a. How much irrigation service fee do you collect per season?

From IA members ____________________
From non members ____________________

IV. GENERAL COMMENTS AND SUGGESTIONS

1. How do you rate the performance of the CIS considering the following aspects?

	WET SEASON			DRY SEASON		
	Excellent	Fair	Poor	Excellent	Fair	Poor
a. Water distribution						
b. Water adequacy						
c. Water timeliness						
d. Maintenance of facilities (dam, gates, etc.)						
e. Cleaning/clearing of canals						
f. Adherence of majority's farmers to cropping pattern						
g. Cooperation of farmers in activities related to irrigation and farming						
h. Working relationship with NIA						
i. Ability to pay CIS amortization						

2. Give your comment(s) for (further) improvement of CIS and irrigation services to farmers ____
____
____.

Annex 4. Record of farming activities and ISF collection information

IAMIS FORM 1

RECORD OF FARMING ACTIVITIES AND ISF COLLECTION INFORMATION

_ NATIONAL IA
_ COMMUNAL IA

IND:

TSA/SECTOR ____________
YEAR/SEASON ____________

SERVICE AREA ________________
ACTUAL AREA ________________

TARGET DATE : ____________
ACTUAL DATE : ____________

LOT NO.	LANDOWNER OR TILLER	FARM AREA	FARM ACTIVITIES (WEEKS)																											PLANTED AREA (HA)	HARVEST AREA (HA)	BENEFITED AREA (HA)	GROSS PROD'N (CAV)	ISF				AMOUNT PAID (P)	O.R. NO.	DATE PAID	REMARKS
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27					CA (P)	BA (P)	INTEREST (P)	TOTAL (P)				
WEEKLY TOTALS (Ha)																																									
AWS (mm./day)																																									
ALS/LP																																									
ACM																																									
ATD																																									
AH																																									

LEGEND:

LSP - LANDSOAKING / PREPARATION
SP - SEEDBED PREPARATION
DS - DIRECT SEEDING
T - TRANSPLANTING
CM - CROP MANAGEMENT
TD - TERMINAL DRAINAGE

PREPARED BY :

____
TSA /SECTOR LEADER

NOTED BY :

____
CHAIRMAN, IMC

Annex 5. *Summative record of farming activities and ISF collection information*

IAMIS FORM 1A

SUMMATIVE RECORD OF FARMING ACTIVITIES AND ISF COLLECTION INFORMATION

NAME OF IA ______________
YEAR/CROP SEASON ____________

SERVICE AREA ______________
ACTUAL AREA __________

__ NATIONAL IA
__ COMMUNAL IA

TSA/BSM/SECTOR	SERVICE AREA (HAS.)	PROGRAMMED AREA (HAS.)	FARM ACTIVITIES (WEEKS) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	PLANTED AREA (HA)	HARVEST AREA (HA)	BENEFITED AREA (HA)	AVERAGE YIELD (CAV/HA)	ISF CA (P)	SA (P)	INTEREST (P)	TOTAL (P)	CME	REMARKS
WEEKLY TOTALS (Ha)																																							
RWS (mm./day)																																							
ALS/LP																																							
ACR																																							
ATD																																							
AH																																							

* CME - CANAL MAINTENANCE EFFICIENCY, expressed as the : ratio of Total Length of Canal Satisfactorily Maintained and the Cumulative Length of Canal for Maintenance

TLC SM
CL CM

PREPARED BY :

____
CHAIRMAN, IMC

Annex 6. Season O&M performance assessment

IANIS FORM 2

SEASONAL O & M PERFORMANCE ASSESSMENT

NAME OF IA ______________
REGION/ISO/PIO ______________
CROPPING SEASON ______________

TOTAL AMOUNT OF AMORTIZATION DUE TO NIA, P ______________
TOTAL AMOUNT OF AMORTIZATION PAID TO NIA, P ______________
ANNUAL RATE OF AMORTIZATION, P ______________

__ NATIONAL IA
__ COMMUNAL IA

PARAMETERS	TSA 1/BSM 1 /SECTOR 1	TSA 2/BSM 2/SECTOR 2	TSA 3/BSM 3/SECTOR 3	TSA 4/BSM 4/SECTOR 4	TOTAL
1. SERVICE AREA (Has.)					
2. PROGRAMMED AREA (Has.)					
3. IRRIGATED/PLANTED AREA (Has.)					
4. BENEFITED AREA (Has.)					
5. AVERAGE YIELD (Cav./ha.)					
6. TOTAL COLLECTIBLES (P)					
6.1 Current Accounts					
6.2 Back Accounts					
7. TOTAL COLLECTIONS (P)					
7.1 Current Accounts					
7.2 Back Accounts					
8. OTHER IA INCOME (P)					
9. IA EXPENSES (P)					
9.1 Regular O & M					
9.2 Repair/Improvement					
9.3 Amortization					
9.4 Others					
10. FINANCIAL VIABILITY					
10.1 ISF - BASED					
10.2 ISF + OTHER INCOME					
11. CANAL MAINTENANCE EFFICIENCY (%)					

PREPARED BY :

____
CHAIRMAN, FMC

APPROVED BY:

____
IA PRESIDENT

FMIS Institutional Status of Inventory of Zanjeras in Ilocos Norte, Philippines

Ruth Ammerman Yabes[12]

INTRODUCTION

In Southeast Asia the subak, or irrigation societies, of Bali, Indonesia, the muang-fai irrigation systems of northern Thailand and the zanjera of the Philippines are communal irrigation systems with traditional water management systems. Zanjeras are a well-known example of communally created and operated irrigation in the northwestern part of the Philippines.

Zanjera are groups of water users with organizational structures and leadership rules that allow them to be in charge of their irrigation environment and to manage that environment with a considerable degree of effectiveness within the natural limits of the habitat and the technical limits of the physical apparatus at their disposal. Most zanjera irrigation activity is undertaken without government assistance or intervention.

However, despite the strength of zanjera throughout Ilocos Norte, beginning in 1978, the two-phase Ilocos Norte Irrigation Project (INIP) was designed by the National Irrigation Administration (NIA) as a "new," large-scale irrigation project, to bring in additional water supplies and to introduce hydropower to the region. The zanjera were a part of the setting for the Ilocos Norte Irrigation Project (INIP), which were unfortunately largely ignored by the original project planners. It might be said zanjera were not so much unknown as undervalued. They were known but disregarded by NIA and INIP's Japanese planners and donors. Yet zanjera have a long history which cannot be ignored. Nor did the zanjeras ignore INIP. Zanjera officers and members protested loudly against the intervention by NIA with its irrigation project which was developed with almost no involvement of the zanjera.

This paper examines the origins and organization of the zanjeras and includes a discussion of the organizing principle of the atar, or membership share. A review of zanjera rules reveals who participates in them and in what ways. The benefits of zanjera participatory activities, which include productivity, equity and community solidarity are examined. Challenges to zanjera activities are also explored. Plans to develop irrigation in the region of the zanjera are inadequate when they fail to include information about existing local irrigation institutions. The last section discusses how institutional information needs to be effectively incorporated into a zanjera inventory and how this information can be used.

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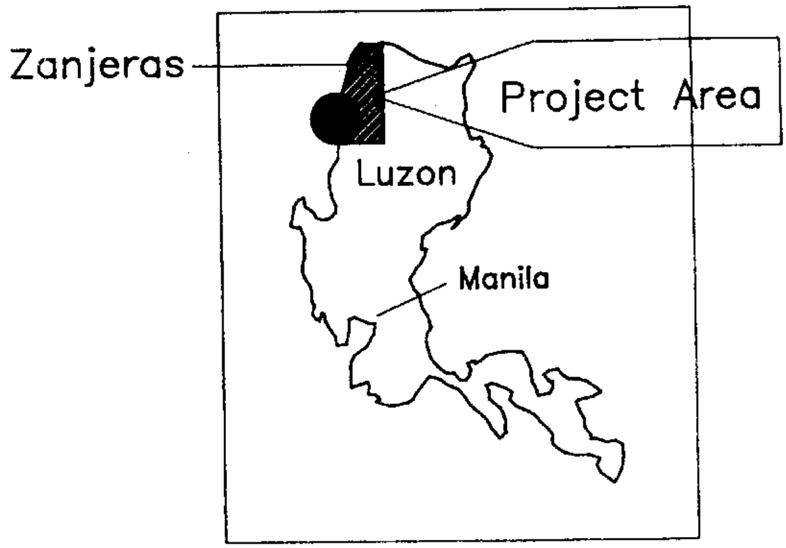
ZANJERA ORIGINS

The term zanjera is derived from the Spanish word zanja, which means ditch or conduit. Zanjeras are organizations that build and maintain irrigation ditches. They are known in the Philippines and abroad for their enduring capacity to manage gravity-fed communal irrigation systems, and for their rules and regulations governing water allocation and distribution, system operation and maintenance and conflict management (Christie 1914; Coward and Siy 1983; Coward 1979; Lewis 1971, n.d.; Siy 1982, 1987; Thomas 1978;Visaya 1982). Some of the larger zanjeras are divided into smaller units called gunglos.

Figure 1. Map



There are between 1,000 and 1,200 zanjera in Ilocos Norte (Figure 1). They range in size from one to a thousand hectares. Scattered throughout the province, their total land area in Ilocos Norte has been estimated from a low of 15,000 hectares by Christie in 1914 to 32,592 hectares by Thomas in 1978. As of 1984, the Philippine Ministry of Agrarian Reform identified 10,664 "farmer-tillers" cultivating an aggregate area of 7,686.33 hectares in the INIP project area (Ministry of Agrarian Reform 1984) which contains approximately 180 to 200 zanjeras, according to INIP project manager.

ZANJERA ORGANIZATION

Zanjera diversion dams, made of brush, sticks, stones and leaves, wash out five to ten times each year, depending on the weather. Water from these dams flows into earthen canals which must be regularly cleaned of grass, debris and silt. Work parties are formed by zanjera members, on either a regular or an emergency basis, depending upon circumstances, to construct and repair dams and clean canals. Individual work assignments vary according to the difficulty of the tasks undertaken, from as little as one to two hours of work by a few persons for canal cleaning, to up to six to nine days of continuous work by over 400 men for completely re-building the largest of the dams. Members may contribute from five to eighty days of labor per year depending upon the severity of the weather and other factors (Yabes 1990).

The Atar, or Membership Share

Some, but not all, zanjera work on the basis of the atar or membership share. The atar is one of the key principles behind member participation in zanjera activities (Coward 1979; Siy 1982; Coward and Siy 1983; Lewis n.d.). The word atar means "share". It is at one and the same time a unit measure of land, as well as a system of rights and responsibilities (Yabes 1990). The number of atars in a zanjera is fixed when it is initially organized. They do not change over time subsequently unless the zanjera physically expands its area. Atars are neither uniform nor specific, and so they vary in the land area they represent. For example, an atar might be one-fourth of a hectare in one zanjera and two hectares in another.

Zanjera with atar memberships base their system of rights and obligations to land, labor and water on this division. Labor and material resources required to be contributed are proportional to the number of atars held.

Organizational Structure of the Zanjeras

The organizational structure of zanjeras reflects their physical complexity and size. Smaller, simpler zanjeras have only a leader (panglakayen) and a secretary/treasurer. Larger ones often have several types of officials, such as president, vice president, secretary, treasurer, auditor and a board of directors. Sometimes there are appointed advisers and cooks.

Zanjera Danum is an example of one of the more complex zanjeras. It has two sets of functionaries. One set of officers governs everyday water management activity. These individuals are elected from among the membership, and therefore, may be tenants, lessees or owner-operators. This set of officers has three levels which correspond to the physical arrangement of the irrigation system. The Lowest level encompasses each of Danum's thirty-three gunglos (sub-sections) which are coordinated by panglakayen, with the help of gunglo secretaries and sometimes and additional vice-panglakayen or other gunglo officer. At the next level, the zanjera is physically divided into three sections which correspond to three lateral canals. A segundo cabecilla heads each of these sections. At the highest level, the overarching leadership roles consists of the mayor cabecilla, secretary, sub-secretary and treasurer.

A second and separate set of officers represents the landowners of Danum. This group includes a president, vice-president, secretary and board of directors. The president's position is traditionally held by a descendant of one of the four original landowning families in the zanjera.

ZANJERA PARTICIPATION IN IRRIGATION ACTIVITIES

Zanjera members participate in all aspects of the communal irrigation system. Zanjera resource management activities and their rules reflect the physical and organizational characteristics and requirements of each system. The extent and nature of each member's participation depends on the type and range of tasks undertaken by each zanjera. The area to be irrigated, the complexity of the physical environment (topography, water source, soils), and the stability of the irrigation structures (temporary versus permanent) are the governing factors (Yabes 1990).

Zanjera members participate in most of the four kinds of irrigation management activities suggested by Uphoff (1986: 37-57), dealing with: 1) water use; 2) control structures; 3) internal organization; and 4) external organization (not discussed here).

Participation in Water Use Activities

Uphoff defines water use activities to include: 1) acquisition, 2) allocation, 3) distribution and 4) drainage (Uphoff 1986: 38, 42-45). Discussions with zanjera officers revealed extensive farmer participation in the first three categories with little or no attention to the fourth (not discussed here).

Acquisition. Zanjera acquire water through their temporary brush dams. Construction and repair of these dams are central to the operation of the zanjera irrigation systems. Thus, most zanjeras require *all* members to help build brush dams or to pay instead a substantial annual fee to be a non-working member. For example, in Danum a non-working member must pay an annual fee of P140 ($US 7), and in some of Danum's gunglos, an additional P150 ($US7.50) annual fee to the gunglo (Yabes 1990). Members contribute labor, materials and sometimes cash as needed for building these brush dams in order to divert water for irrigation.

Allocation and Distribution. In order to ensure sustained delivery and equitable distribution of irrigation water, zanjera have water allocation rules for water-sharing arrangements within their own groups as well as with other zanjeras. These include dates and times for water delivery, labor schedules and assignments for rotation activities, and various punishments and fines for water stealing and other distribution-related offenses.

Water distribution activities vary between the wet and dry seasons in response to variations in the water supply volume. Forty of the 45 zanjeras surveyed in the INIP project area indicated that they use continuous flow irrigation in the wet season when water supplies are relatively abundant (Yabes 1990). Farmer participation during continuous irrigation periods focuses more on responding to excess water emergencies rather than on settings up distribution schedules, over three-quarters of the zanjeras (37 out of 45) said they use rotational [squadra or cuadra] irrigation, while about one-ninth (5 out of 45) use continuous irrigation since they are supplied by perennial springs or drainage.

Participation in Control Structure Activities

Zanjera members are actively involved in the design, construction, operation and maintenance of their canals and structures. This participation contributes to the long-term sustainability of their systems. Field interviews with zanjera officers and individual farmers identified a range of types of participation in control structure irrigation activities. Uphoff (1986: 38, 45-46) lists the following participatory activities for control structures: 1) design, 2) construction, 3) operation and 4) maintenance.

Design and Construction. Zanjera brush dams vary in terms of size and type of construction materials in response to variations in river volume and velocity and availability of materials. One brush dam design example is from Zanjera Pam-pan-niki and Zanjera Kuli-bang-bang, which jointly construct a diversion weir in the upstream portion of the Tina River. These zanjera build a palamag [bundles of brush weighted down by stones] which is made of big branches of the camachile tree tied together. In interviews, zanjera members indicated that the design and technology used to build these structures were passed down from their ancestors who were founding members of the two zanjera.

One indicator of the practicality of the design of zanjera dams is that many of the dams have not changed much in appearance or in type of building material since they were originally constructed in the 1800s and 1900s. To ensure that someone is able to re-build the dams upon destruction by flooding, dam-building skills are shared by more than one member and passed across several generations of zanjera members. Given that the zanjeras' temporary dams wash out frequently, another advantage of the way the brush dams are designed is that the members can re-build them in different places in response to shifts in a river's course and volume, unlike permanent dams which silt up or are damaged when hit by a major typhoon. Members participate in making decisions about changing a dam's location when a shift in position is indicated by a change of the river course or other factors. Zanjera members meet to discuss where and how the dam should be re-built to meet changing conditions.

Operation and Maintenance (Repair). To maintain their irrigation systems, zanjera members are involved in repairing or re-building brush dams, fixing damaged canals or structures such as intakes, and cleaning canals and farm ditches. These activities are performed on a regularly scheduled, routine basis as well as on an emergency, as-needed basis in response to changes in the environment. Routine repair activities include annual, initial repair of brush dams, and semi-annual canal cleaning, checking and correcting of minor structural damages, plus other activities. Emergency or special repairs and maintenance occur when the brush diversions, culverts, access roads and other structures have been damaged due to typhoons, heavy rains and/or flooding.

Coward mentions two formats of labor required for repair, operation and maintenance activities in Danum (Coward 1979:32). Both types of labor can be regularly scheduled or called for an as-needed basis. The first type, dagup labor requires the zanjera's entire membership for tasks such as major brush dam repairs or cleaning canals before the rainy season begins. The second means of organizing labor is sarungkar for routine maintenance and repairs, which can be handled by smaller work parties, as well as for other functions.

Participation in Internal Organizational Activities

Uphoff identifies decision-making, resource mobilization, communication, and conflict management as four generic organizational activities in irrigation water management (Uphoff 1986:40, 46-53). Two of these activities--zanjera resource mobilization and conflict management activities--especially contribute to zanjera management. One of the strongest characteristics of the zanjeras is the high level of participation by its members in organizational activities. Zanjera officers and members are known to work together closely.

Resource Mobilization. Construction and repair of zanjera dams, structures and canals require extensive labor, materials and food contributions and coordination of large work parties. Many of the zanjeras studied have detailed rules governing the mobilization of these contributions for dagup (major repairs and clean-up) work days. Zanjeras with atars favor proportional contributions. For example, when Danum holds a work day to repair its dam, work assignments are made both between and within gunglos. Work is assigned by zanjera officers in proportion to the number of atars in each gunglo and enforced by the gunglo panglakayen. On the other hand, to repair the brush dam, work is assigned to each gunglo by measuring and dividing the dam into equal portions. One section is assigned to each gunglo so there will be equal work for each group, regardless of the number of atars in each gunglo. Or, within each gunglo, when a dagup is scheduled, a notice instructs each member with one atar to bring a length of bamboo. At the dagup itself, some members are assigned to gather leaves or bundles of grass for the dam, while others have to gather and place stones on the diversion dam.

The repair and cleaning of brush dams and structures require a variety of materials to be contributed by zanjera members. Tools such as shovels, wheel barrows and bolo knives are needed for digging and repairing the dams, and cutting overgrowth in the canals. Materials used to construct the diversion dams include stones, river rubble (gravel), leaves and brush, bamboo poles and wood. Rules exist which govern how these various resources are mobilized in most zanjera.

Conflict Management and Penalties. The longevity of many zanjeras can be attributed in part to their conflict management activities. Mediation is used by most zanjera officials to resolve conflicts within or between zanjera. Even though some zanjera have by-laws which mention the possibility of court action, most of those in the research area resolve conflicts internally, without resorting to litigation.

Member attendance at zanjera work activities is crucial to the operation and management of their irrigation systems. Fines *[multa]* are the most common penalty for breaking zanjera rules such as absence from required zanjera activities. Forty-one out of 45 of the zanjeras surveyed have fines for missing a dagup work day, while 20 out of 45 had fines for water distribution offenses which include water stealing.

Given the scarcity and high value placed on irrigation water in Ilocos Norte, zanjera members consider water stealing as one of the most serious offenses possible. This is reflected in the stiff penalties some zanjera impose on anyone caught stealing water from a canal out of turn. In the majority of zanjera surveyed, the fines for water stealing (a water distribution offense) are much higher than fines for other types of offenses. Ten zanjera specified a fine of P50 to P100 (US$ 2.50 - $5.00), which is a severe penalty for zanjera members.

CHALLENGES FACING ZANJERA

The temporary nature of the zanjera brush dams is the greatest challenge to the zanjeras according to some of the zanjera officers interviewed. Because the brush dams are made of non-permanent materials which are washed out easily, frequent repairs and maintenance are required. Some zanjera officers complained of the extensive work they have to do to organize and schedule voluntary labor by zanjera members for both routine and emergency repairs and cleaning of zanjera brush dams and canals.

Other zanjera officers complain that it is much harder now to motivate and coordinate members to contribute voluntary labor for irrigation tasks. A number of the zanjera surveyed during the research complained about members' absences on scheduled work days, and the fact that many of these absent members refused to pay (or simply ignored) the fines for absences.

Another difficulty facing zanjera is getting access to additional sources of irrigation water. Many of them obtain water from individual river diversions or springs, acting independently of the others. In some areas obtaining water by individual zanjera reinforces an "upstream"/"downstream" pattern among them, where the downstream zanjera feel that they are not getting enough water. It is difficult for downstream zanjera to gain access to additional water sources. An inadequate water supply was the problem most frequently mentioned by zanjera when asked in the research to list their most pressing problems.

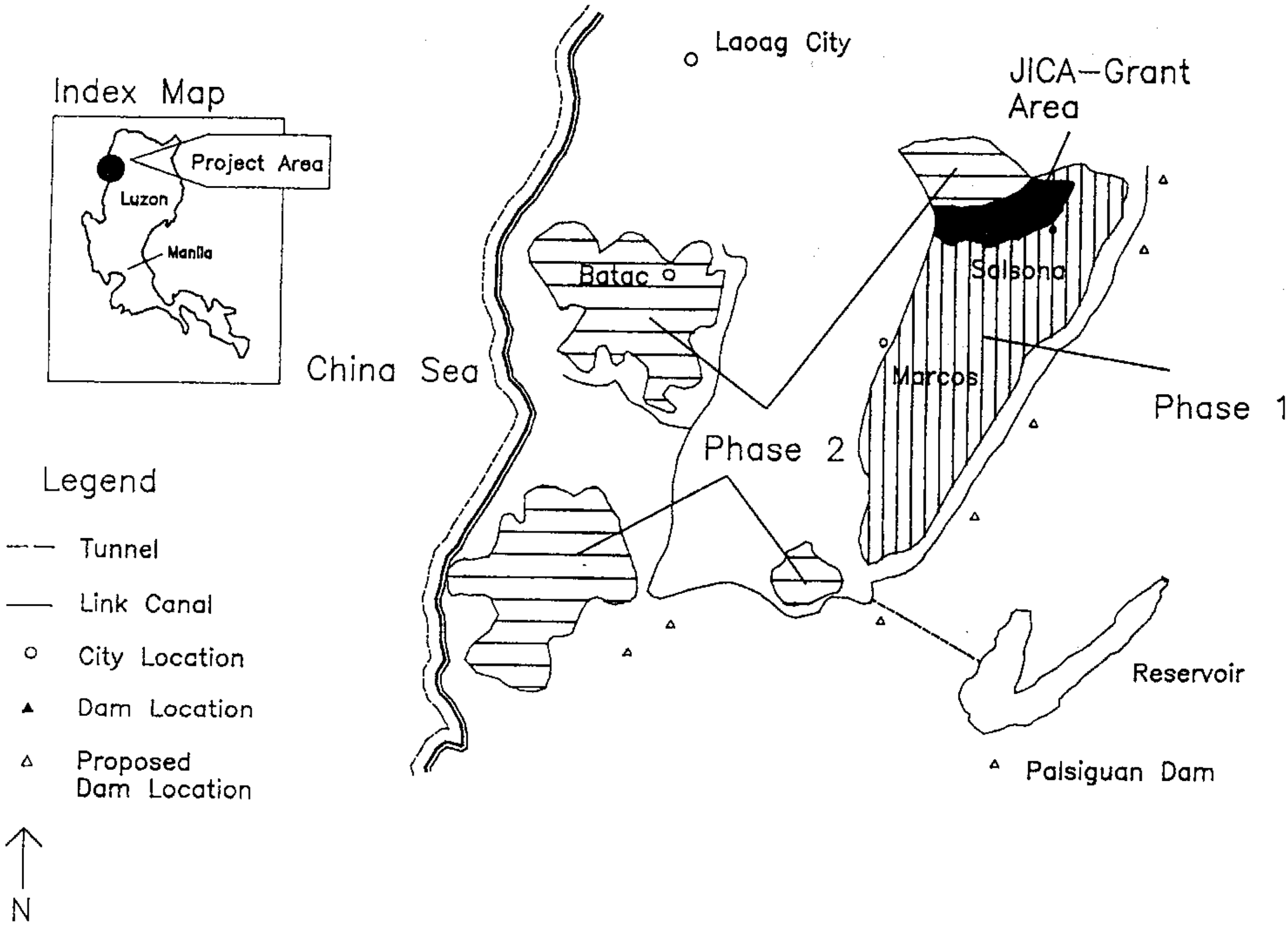
In order to bring in "additional irrigation water supplies," NIA designed and created INIP and its JICA-grant area, to strengthen the "inefficient," unlinked system of scattered zanjera brush dams. As seen in the following section, NIA and its INIP project introduced new and different requirements for irrigation activities and for farmers involvement (or the lack of it)--NIA style, not zanjera style--in irrigation development and organizational activities.

A NEW CHALLENGE TO THE ZANJERA: INTERVENTION OF THE ILOCOS NORTE IRRIGATION PROJECT (INIP)

NIA introduced the Ilocos Norte Irrigation Project as an opportunity for improved irrigation development and increased agricultural productivity for the province. However, to some of the zanjera the INIP was a challenge--to others a threat--to the existence and operation of the zanjera irrigation systems.

In 1978 an area of eastern Ilocos Norte, with almost 200 zanjera operating in it, became part of the Ilocos Norte Irrigation Project (INIP) designed by NIA. NIA intended to introduce INIP as a new, national irrigation system to Ilocos Norte. INIP's total area was estimated at 22,600 hectares, or 76.2 square miles,almost twice the size of the city of Boston (Figure 2). The plan aimed to increase agricultural production which would benefit 17,500 farm families in the area through the provision of improved irrigation facilities (JICA 1980b:3). It also promised hydropower to generate electricity to Ilocos Norte. Plans for the project included two phases of development, called Phase I and Phase II; however, Phase II was officially shelved by NIA Central Office in December 1985. A 1000-hectare pilot project, funded by the Japan International Cooperation Agency (JICA), and called the JICA-grant area, was contained within the boundaries of INIP's Phase I area.

Figure 2. Ilocos Norte Irrigation Project (INIP) regional location map



NIA applied a standard, engineering-oriented planning approach to the JICA-grant area and to preconstruction activities in its Phase I area. This focused on physical planning activities and ignored the social and institutional setting, including the zanjera.

NIA ran into implementation and scheduling problems in the JICA-grant and Phase I areas. Farmers protested loudly against the project, and NIA's Administrator from Manila as well as some social scientists from Manila and Tokyo came to see the project's problems for themselves. Based on their observations, NIA decided to undertake a more participatory approach as an alternative to the standard process. The revised approach promised opportunities for zanjeras to participate in INIP's ongoing planning activities.

JICA-Grant Project Plan

NIA requested a Japanese survey team to develop the JICA-grant project. The JICA-grant project was designed to provide irrigation and drainage systems with "terminal facilities" to an upstream area served by the Labugaon River in the municipality of Solsona. This project was to assist farmers with water management techniques of terminal facilities. The Japanese team focused on these techniques because they said it is the:

> terminal water management technique which is a bottleneck to increase [sic] the effect up to the target in many irrigation projects which have been implemented (JICA 1980a:24).

The JICA-grant project was to be finished prior to construction of Phase I components (JICA 1980a:6, 25).

INIP's Phase I Plan

In Phase I, INIP project planners proposed to build a new network of irrigation and drainage canals supplied by five new major diversion dams. These five dams were to be constructed across the Labugaon, Solsona, Madongan, Papa and Nueva Era Rivers. These new irrigation networks proposed to cover an area including almost 200 zanjeras, though no details were given in INIP's feasibility study to integrate these existing zanjera systems into the new NIA network of irrigation canals and dams.

INIP's plan acknowledged the presence of communal irrigation systems in the area, but gave them very little attention within its engineering, agricultural or institutional components. The existing systems were mentioned only eleven times--for a total of less than three pages--in a 200-page report! Furthermore, they were never called by their correct name of "zanjeras." The feasibility study cited water losses due to deteriorated irrigation and drainage systems having temporary brush dams and "insufficiency in water management due to intricated [sic] canal networks." (JICA 1980b:4-1). Thus, the plan proposed to modernize agricultural production, where, In the Project Area, irrigation and drainage canals will be newly constructed and/or improved to separate irrigation and drainage systems, and terminal facilities will be rearranged and reinforced (JICA 1980b:4-3).

Planning and construction activities of the JICA-grant project proceeded at a rapid pace in early 1981. NIA used a standard planning process characterized by little interaction with users and little attention to the existing physical or organizational structures of the zanjera irrigation systems to design the JICA-grant area. Problems occurred in the JICA-grant and the Phase I areas (Siy 1987 and Yabes 1990).

ZANJERA RESISTANCE TO THE JICA-GRANT PROJECT

The original design of the JICA-grant area was eventually changed due to resistance by three upstream zanjeras which refused to join the project. Members and officers of these non-joining zanjeras listed several reasons for resisting the project during interviews, including the fact that they had enough water without the NIA project. Others said they did not want to pay irrigation fees to NIA. The zanjeras doubted NIA could provide any extra water and were unwilling to have to pay fees to NIA for water they had always received for free or for a much lower water rights fee. Another reason some resisted the project was that they were afraid many of their small farmlands would be erased or greatly reduced by the wide canals, access roads and facilities proposed by NIA. They also said they wanted to keep their existing zanjera irrigation system and organization which had operated for years, but which would be eliminated and replaced by NIA's new irrigation system.

The upstream zanjera also were against the NIA project because they did not want to give up their water rights or grant NIA the right-of-way (ROW). One major concern for zanjera members in the JICA-grant area was that some of the new canals might take up large proportions of their small plots. Since it was the landowners, and not the tenants, who were to be compensated, the latter also feared that the source of their livelihood would be reduced with nothing received in return.

Despite these changes in the JICA-grant project's location, other system design issues--personnel, design criteria, and opportunity for user input-remained the same. For example, NIA's standard design criteria were used to determine the number and location of turnouts (one turnout per rotational area of thirty hectares)(JICA 1980a). This was in contrast to zanjera turnouts which served varying areas ranging from ten to forty hectares.

A Revised, Participatory Planning Approach to INIP

Eventually, there was a transition to a revised, more participatory planning approach in the Phase I area activities for INIP, beginning in October 1981. Based on observations during several visits to the JICA-grant site NIA Administrator Fiorello Estuar reviewed the JICA-grant project and INIP plans in response to farmer protests and made the very unusual and drastic decision to drop the standard designs. Estuar ordered the Phase I area of INIP to be resurveyed and redesigned according to a revised planning approach.

INIP's objectives were modified, emphasizing rehabilitation over new construction and recognizing the importance of a role for the zanjeras in project activities. Four guidelines for the revised approach included: 1) preserve the identity of the zanjera groups' 2) follow existing canal lines as much as possible, 3) conceive the project as rehabilitation of existing communal irrigation systems, not as construction of a new large-scale system, 4) involve farmer in planning and implementing the project (Visaya 1982).

INIP's participatory approach was conceived through organizational changes in NIA, NIA-zanjera communication-facilitating workshops, and the inclusion of third-party researchers and academics to provide process documentation for NIA's decision-making. This resulted in more interaction between NIA and the zanjeras, with greater attention being paid, in the process of project design, to the latter's physical and organizational structures and to their special development needs.

On the contra side, the participatory approach was resisted by some INIP staff because it was felt to be too time-consuming, and because it would increase the complexity of project tasks, raise project costs, expand staff accountability and change the status quo of planning methods (Yabes 1990).

CONCLUSIONS

The INIP project represents a case illuminating the potential for including institutional information about a farmer-managed irrigation system (FMIS) in order to re-structure a large national irrigation activity where local irrigation systems already exist. It yields several lessons about what might be emphasized or avoided when incorporating information gathered from an institutional inventory of an FMIS and how to use that information in managing that system.

The first essential step of any institutional inventory of an FMIS or a government-managed irrigation system is to define the scope and conceptual framework of the inventory: what items, activities, organizations and personnel are to be included in the inventory? In the INIP project area, one found a whole set of active irrigation groups -- the zanjera -- which fit within a category NIA knows about (communal irrigation groups) and around which the NIA agency has organized a Communal Irrigation Program (de los Reyes and Jopillo 1986; Korten and Siy 1988; Jopillo and de los Reyes 1988). Zanjera irrigation systems are built, operated and maintained by the users of the water. They perform various irrigation tasks and manage conflict. Despite this agency knowledge of communals, one crucial issue in INIP's project planning which must be emphasized is that INIP was conceptualized as a "*new*" national irrigation project rather than as a rehabilitation project of a collection of existing communal irrigation systems. Institutional information about the zanjera was not collected by the Japanese or NIA in the initial project planning stages. Had NIA and the Japanese consultants chosen to develop INIP as a collection of communals, presumably all of NIA's experiences with participatory approaches to communal irrigation systems might have been mobilized.

This oversight can be corrected. In any rehabilitation project or project which embraces some form of existing FMIS, inventory should be taken on the existing organizational structure, leadership patterns, functions and finances of the organization(s); labor system for construction, maintenance and management of the system (amounts, duration, frequency, types of labor) and rules and regulations of the organization, which also includes a history of the FMIS that may provide a rationale for past and present FMIS activities. This information may then be used to create a closer fit between the existing organizational set-up and practices of the FMIS and the proposed rehabilitation activities. NIA already has begun to take steps in that direction. As previously stated, the thrust of INIP's revised, participatory planning approach is to preserve the integrity of the zanjera's organization by designing the irrigation project in a way which builds on the strengths of the original character of the zanjeras rather than trying to change them completely.

Thorough, useful institutional inventories require serious investments of time. The time frame for projects, large and small, should include a sufficient period for community organizers to contact community leaders and organize irrigator associations. The organizers should be sent out several months prior to project formulation and negotiation by potential project donors or contractors. Except in cases of political or personal danger, these organizers should live in their assigned areas.

New and expanded measures of project progress and evaluation should be created to incorporate the institutional dimension of an FMIS or government managed irrigation system. The institutional activities of agency staff such as the Agricultural Cooordination Division (ACD) of NIA should be included in project progress reports in association with detailed coverage of physical accomplishments of projects. Genuine opportunities should be provided by NIA for farmers to raise legitimate concerns and complaints that may fall out of the technical domain and to allow to make timely and adequate responses to these concerns.

As we have seen, the zanjera are a very specific kind of communal group, with complex participatory practices which are not always present in other irrigation groups, or other kinds of local organizations. In a future case of project planning and management, it would be wrong for project planners to assume that existing local organizations might have the same kind of participatory practices and capacities as those of the zanjeras. Thus, a key initial part of any participatory planning approach is to profile the characteristics, history, context, capabilities and weaknesses of the potential local organization before any project decisions are made in order to ensure the successful management and operation of the technical irrigation system.

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Evolving a Management Information System for Irrigators' Associations

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INTRODUCTION

This paper documents the procedure adopted in evolving a management information system for Irrigators' Associations (IAs) using the results of the self-assessment of irrigation system performance by farmer leaders in a river irrigation system in the Philippines. The management information system aims to strengthen the IA's managerial capability by introducing a systematic process for planning and monitoring IA activities, improve farmers' capacity to analyze the performance data they themselves have collected and to link the IA's management information system to the National Irrigation Administration's (NIA) information needs. The paper poses several challenges both for the farmer organization and for the partner agency in order to sustain the feedback mechanism instituted.

In 1991, the Bicol University (BU) together with the National Irrigation Administration (NIA) Region V, and IIMI Philippine Field Operations introduced a self-assessment mechanism for measuring Irrigators' Association (IA) performance in two farmer organizations in Nabua, Camarines Sur (about 400 km South of Manila). The project covered an aggregate of 2,636 members and 106 farmer leaders. Encouraging the use of the self-assessment process among farmer leaders as a routine performance monitoring mechanism within the organization became an impetus for evolving a management information system in the IA. This paper analyzes the process adopted by the farmers in developing a management information system for their organization.

RATIONALE

IAs have been organized to operate and maintain irrigation systems in cooperation with NIA. In recent years, IAs have been assuming important system management responsibilities, particularly those under Type II and III contracts. Under the Type II contract, farmer organizations assume system operations and irrigation service fee (ISF) collection functions. System operations include: 1) planning and undertaking O & M activities from the turn-out to the main farm and supplementary farm ditches; 2) planning implementation and monitoring of the cropping calendar; 3) water allocation and distribution; 4) conflict management and 5) maintaining linkages between farmer users and NIA. Collection functions include: 1) planning effective collection strategies; 2) distribution of ISF bills and 3) undertaking ISF collection. Meanwhile, Type III contracts involve full turnover of all or part of the irrigation system to the farmers. Although the farmer leaders of IAs undergo leadership training before their

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13 Project Leader and Study Leaders, BU-NIA-IIMI Project to Strengthen the Management Capability of Irrigators' Associations in Bicol, Philippines

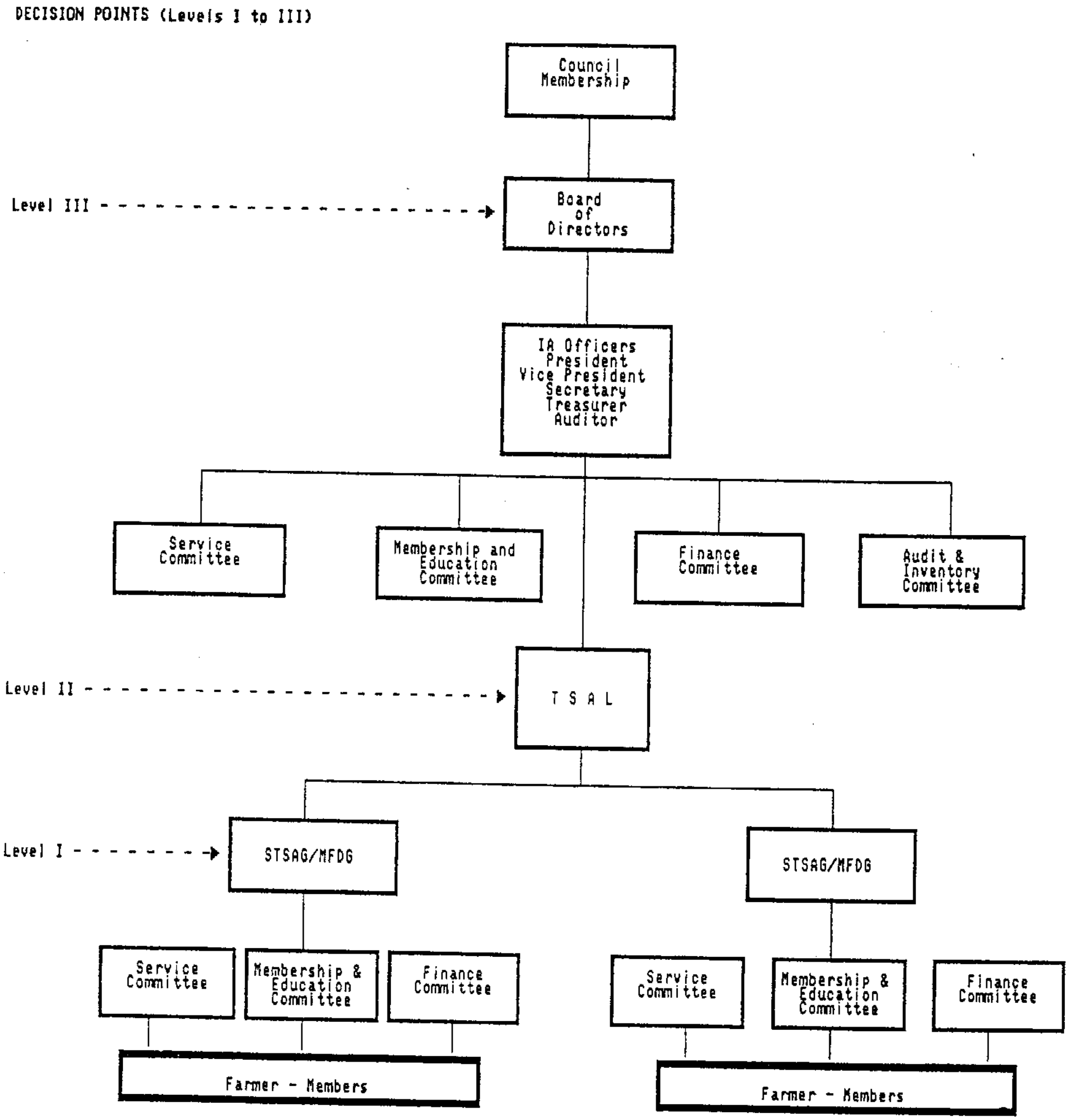
organizations assume these tasks, they have not successfully internalized mechanisms that strengthen management capabilities in order to face the challenges poised by their new irrigation management responsibilities. Thus, self-assessment of performance by farmer members and farmer leaders was conceived. The objectives of self-assessment are as follows: 1) monitor and evaluate performance of irrigation systems in general and IAs in particular; 2) introduce a learning process to identify and characterize the types of strategies that could be used internally by farmers to catalyze collective action; 3) strengthen the IA's managerial capability by introducing a systematic process for planning and monitoring IA activities (both for operations and organizations); 4) improve farmer capacity to analyze the performance data they themselves have collected; and 5) link the self-assessment scheme with NIA's information system.

As the term suggests, self-assessment required the turn-out service area (TSA) leaders to gather data pertaining to the situation of his turn-out which are indicative of how well he is performing his O & M and institutional development responsibilities. This self-correcting scheme is complemented by participatory assessment by farmer-members at the lowest stratum of the organizational hierarchy, as spearheaded by the farmer-leaders at supplementary ditch levels. Utilization of the TSA Leaders'performance report by the Board of Directors (BOD) and officials at the central level of the IA completes the information flow to the decision points of the organization.

Figure 1 illustrates the relationship of the organizational structure to the information flow required by IA decision-makers. Levels I to III are the stages where the data are generated, analyzed and acted upon.

Tracing the information flow in the organizational structure of the IA, the TSA Leaders are the vital link between the IA Central Level Officials and the mass-based membership. If the TSA Leaders are inactive, the chain in the information flow is broken, resulting in inaction. Given this strategic role of the TSA Leaders in the organization, the IA officials should have an information system that would enable said officials to monitor TSA leaders' performance. Considering that the TSA leaders are already collecting the data that reflect capability to carry out their mandated functions, the next step was to put in place a mechanism that would channel and process the information from the TSA leaders to the central level officials and the BOD. Data generated by the TSA leaders not only captures their performance indicators but also covers information pertaining to the status of irrigation structures, farm data needed to establish probable collection level of irrigation service fees, and problems and issues experienced by the members.

Figure 1. Organizational structure of the IA adopted by the action-research project



CONCEPTUAL FRAMEWORK AND METHODOLOGIES USED

Conceptual Framework

The self-assessment process serves as primary data source for the management information system of the IA. A sound feedback mechanism shall have a direct consequence on the level of performance of supplementary, turn-out service area leaders and IA officials which in turn shall have bearing on the degree of effectiveness of the farmer organization in delivering services to the water-users. NIA would also benefit from the IA's Management Information System by facilitating its data generation requirement at the grassroots level. It may be mentioned that as part of the project's intervention activities, the O & M personnel have adopted their own performance assessment system utilizing the data reported by the TSA leaders. Through regular interaction with the farmer-leaders, NIA personnel are provided with timely information that could be used as a basis for planning the O & M work of the agency. The designed reciprocal action between the agency personnel and the farmer-leaders is hoped to result in a better working relationship between water management partners that would lead to improvements in irrigation system performance.

Figure 2. Conceptual framework

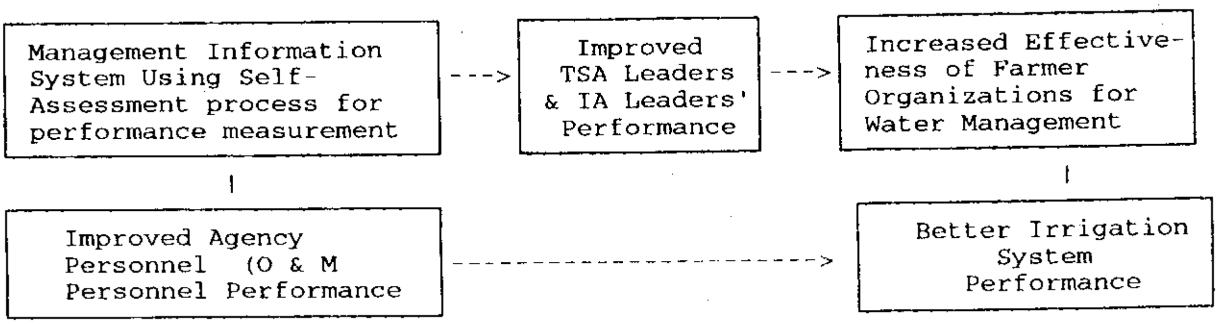


Figure 2 illustrates the schematic flow of expected results of the Management Information System

Methodologies Used

1. *Establishing IA Profile as baseline data.* At the onset, farmer leaders felt the need for baseline data that would establish the profile for the organization. Using the spot mapping technique, TSA Leaders sketched their service areas to reflect: a) boundaries of turn-out service area, supplementary and main farm ditches; b) lot number and lot area; c) structures and facilities; d) names of owners/tillers and e) tenurial status. These data were deemed useful by the IA as a basis for membership campaign and collection of membership dues. On the part of the NIA, the spot map data updated the list of water users and validated farm areas for billing purposes. Although the said agency has an existing reporting mechanism (IAMIS), such is not currently adopted in the field due to its present format which requires voluminous data on a per farmer basis. Initial results showed that there are a number of farm lots not presently registered with the IA and the NIA that are using irrigation water but are not billed. For the next cropping

season, it is expected that there will be an increase in irrigation service fee collection due to the inclusion of newly identified water users in the IA/NIA's billing list.

2. *Data Generation.* As mentioned earlier, the information system of the IA utilized self-assessment of the performance by the TSA Leaders (including the leaders at the lower level of supplementary ditches) as primary inputs. In designing the self-assessment tool, the project team has taken into account the dynamics of the IA organizational activities vis-a-vis farming activities. Farmer leaders are analyzing the data they themselves have collected. A sample of the data gathering instrument is herein attached as Annex 1. Through a series of consultation meetings with farmer leaders the instrument was streamlined to reflect the most essential questions needed by the TSA Leaders to carry out their functions. The questions had also been transformed to facilitate recording but at the same time draw out vital information for planning and decision-making. Data gathered cover the areas of water management, organizational activities, maintenance, conflict management and farming activities. Inasmuch as the self-assessment process had been structured to capture the indicators of performance of the TSA Leaders, a list of the latter's duties and responsibilities was attached to the questionnaire. This list served as the link between the self-assessment process and the farmer leaders' mandated duties. By emphasizing the objective of the self-assessment process, to support TSA Management, the researchers gained the farmer leaders' cooperation for the recording process. The spotmap drawn by the TSA Leader contains valuable baseline data and was appended to the self-assessment questionnaire. The spotmap served two purposes: a) as areference point in filling in the questionnaire and b) as a place to record status of canals and facilities.

On the part of NIA, each ditch tender is assigned a specific area of assignment within the IA's service area and has a TSA Leader as counterpart for the O & M task. Since their duties are complementary, the researchers believed that the ditch tenders should also gather field information reflecting the situation in the turn-out which is relevant to the TSA leaders and their performance. Thus, a monitoring form was devised for use by the said personnel, which is attached as Annex 2. The form contains data on farm activities, planted and harvested area, TSA leaders and ditch tender performance, length of canal cleaned and maintained, level of collection, status of structures, etc.

3. *Data Processing.* The TSA Leaders, by virtue of the IA by-laws automatically comprise the BOD, the central decision-making body of the organization. In the pilot IAs, one IA has 59 TSA Leaders, while the other has 47. To facilitate reporting and processing of data from the self-assessment results done by the TSA Leaders, the "small group" concept was adopted at the IA central level whereby each IA official was designated to oversee a group of TSA leaders. Given the present number of 6-7 positions (president, vice-president, secretary, treasurer and auditor; one IA opted to elect an assistant secretary) each IA official is responsible for 7-8 TSA leaders. He is assigned to supervise the accomplishment of the self-assessment tool, consolidate results and report the same to the BOD during its monthly meeting.

Inasmuch as the performance data collected by the ditch tenders covers both the areas of responsibility of the TSA Leaders and the ditch tenders the watermaster is provided a complete picture of the system for his own planning and decision-making function at this supervisory level. He then channels the consolidated report to the irrigation superintendent (IS) for action called for at this higher level. The ditch tender and the watermaster were designated by the IS to be NIA's representative to IA's BOD meetings or assemblies where NIA's participation is needed. This arrangement facilitates the resolution of issues brought about during BOD meetings needing NIA attention. NIA's institutional development officer (IDO) is responsible to organize IAs and to develop training programs for farmers based on training needs identified by the O & M personnel.

LESSONS AND CHALLENGES FOR SUSTAINING A MANAGEMENT INFORMATION SYSTEM

At the time when this paper was written, the project team had just finalized the design for the self-assessment tools both for the IA's and the NIA's O & M personnel. Even at this early stage the project team has experienced several things which deserve reflection about the process.

While we recognize that information is a key ingredient in decision-making, and it is important for organizations to devote attention to designing appropriate systems of information flow (Kast and Rozensweig, 1974), it is usually important to recognize the capability and resource at each decision point in the farmer organization to match the scope and influence of their decision-making functions. In the case of the IAs, the TSA leaders in LAPSEFIA (which has a Stage II contract with the NIA), are responsible for clearing and maintaining farm ditches and have the authority to decide on how they will undertake these obligations. Repairs, scheduling of cropping calendars and budgeting are all decisions within the realm of the central decision-making body, the IA BOD. Prior to the introduction of a pilot management information system, the generation and disbursement of funds were centralized functions of the organization. TSA leaders were not provided with regular funds which they can use to act on matters within their authority. The only resource available to them is voluntary services from members, which also requires mobilization funds for meals or snacks as incentives. A challenge that IA Leaders should ponder is how to provide real incentives to farmer leaders to turn in higher performance and to act on the problems and issues resulting from the feedback mechanism instituted. As Goonesekera concludes (cited in Merrey, Rao and Martin, 1988), there is a need to provide irrigation managers with financial incentives to provide good management. For a start, LAPSEFIA and BRISDAFIA (the two IAs covered by the project) have centralized the collection of annual dues from members. As much as 90% of such dues are now retained at the TSA level as seed money for TSA activities. On the average, each TSA stands to collect about P250.00 (US$ 10.00) per year, which is very meager indeed. Another means for increasing funds is to intensify ISF collection by systematizing collection procedures and providing higher incentive pay for IA collectors.

Feedback from the President of the IA attests that the information system will serve as a basis for farmer-leaders in providing direction for the organization as a whole. However, IA officials are pressured to act on problems that are supposed to be within NIA's realm of responsibility, in order to maintain the feedback mechanism instituted at the farm level. Because of farmers' increasing awareness of the condition and performance of their irrigation system, they have become more "demanding" of NIA to fulfill its part for operating and maintaining the system.

The constant reference to inaction of NIA on problems (which surfaced during the participatory assessment process conducted in 1991) was a learning experience in itself. Henceforth, farmers were encouraged to identify workable areas given their organization's limited resources and to pin less hope on the NIA fulfilling its part of the O & M contract (given the agency's present financial condition). Researchers observed that when NIA staff were open with farmers about its limited capacity to fulfill its O & M obligations, this triggered positive responses among farmer leaders to act on problems even if they were the legal responsibility of the agency. However, the IAs do not have enough financial resources to undertake major maintenance and repair works required by existing structures. Turn out gates with locks are seen by farmer leaders as critical problems that should be reparied in order to have control over water releases and to impose penalties on undisciplined water-users (through suspension of water delivery). Meanwhile, the IA has come up with a list of rules and regulations with accompanying sanctions for violations to protect the structures and irrigation facilities. IA officials are seeking the conversion of IA policies into Barangay (a political subdivision smaller than but within the Municipal boundaries) or Municipal Council's ordinances or laws as a measure to elicit higher compliance.

CONCLUDING REMARKS

The basic intervention activity employed by the project team is the evolvement of a management information system within the IA that utilizes the self-assessment of performance as primary input. For this system to effectively work, it would need several ingredients as follows:

Firstly, TSA Leaders who recognize the sensitive role they play in the information flow within the organization; who care enough to act on issues and improve their performance for the betterment of service delivery.

Secondly, IA officials who have the vision to set higher goals and steer the organization towards attainment of those goals through sound judgment based on adequate and reliable information.

Finally, an honest assessment of existing capabilities in order to establish a clear-cut role between the agency and the IA as basis for defining areas for action-planning and decision-making is called for.

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Annex 1. Sample self-assessment form

BLOCK B. PAG-MANIHAR KAN TUBIG (WATER MANAGEMENT)			JULY	TO	JUNE
A.	Water Distribution				
	A.1	Pira tabi an parcela nin dagang pigtatanuman sa turn-out an nakakakua nin tamang supply/bastanteng supply nin tubig? (Number of farmlots or parcels of land with sufficient water supply).			
B.	Komunikasyon (Communication)				
	B.1	Pirang para-oma an aram kun nuarin maabot an saindang tubig? (Number of farmers who know when irrigation water is coming).			
	B.2	Pira an dai nagsunod sa cropping calendar (Number of farmers who fail to comply with cropping calendar).			
C.	Rotation (Kun pinag-guiguibo)				
	C.1	Pirang para-oma an nagtatabang sa rotation lalo kun an turn-out nagkukulang o nagtitipid sa tubig? (Number of farmers who participate in rotation when there is insufficient supply of water).			
D.	Pag-resolvir ki Iwal (Conflict Management)				
	D.1	Pira an total na bilang nin mga iwal/dai pagkasinarabutan manongod sa tubig sa laog kan bulan na ini? (Total number of conflicts over water experienced this month).			

BLOCK B. cont'n.	JULY	TO	JUNE
D.2 Pira an total na bilang nin iriwal/dai pagkasinarabutan manongod sa tubig an naresolbir tolos o natawan nin solusyon sa marjay na paagui? (Total number of conflicts over irrigation water that has been easily resolved).			
E. Pag-distribuir ki Trabaho (Task Distribution)			
E.1 Pirang mga para-oma sa laog kan TSA ang pigtawan mo nin trabaho/gigibohon ngonyan na bulan? (Number of farmers given specific tasks this month).			
BLOCK C. PAGPLANO KAN MGA AKTIBIDAD SA ORGANISASYON (PLANNING OF ORGANIZATIONAL ACTIVITIES)			
A. Presensiya sa mga Miting (Attendance in Meetings)			
A.1 Bilang kan TSA meeting na guinibo sa bulan na ini? (Number of TSA meetings held this month).			
A.2 Pirang mga para-oma sa TSA an nag-atindir ki miting? (Number of farmers who attended the meetings).			
A.3 Pirang small group an nagkaigwa ki pamiting sa bulan na ini? (Number of small groups who conducted meetings this month).			
A.4 Pirang mga para-oma sa small group an nag-atindir ki miting? (Number of farmers in the small group who attended meetings).			
Group 1			
Group 2			
Group 3			

Annex 2. Sample form: ditch tender performance monitoring form

NAME OF TSA ____________________

	B-LINE DATA	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	Number of Farm Lots												
BLOCK A. FARM DATA													
A.1 Stage of Farming Activities (Indicate number of farmlots engaged in:)													
a. land soaking and land preparation													
b. planting													
c. crop maintenance													
d. terminal drainage													
e. harvesting													
A.2 Area Planted To Date (Hectares)	Total Area												
A.3 Status of Crops													
a. hectares damaged													
b. hectares in satisfactory condition													
A.4 Extent of Harvested Area To Date (Hectares)													
BLOCK B. WATER DISTRIBUTION													
B.1 No. of farmlots with sufficient supply of water													
B.2 In equivalent hectares													
B.3 No. of farmlots without water from irrigation													
B.4 In equivalent hectares													

	B-LINE DATA	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	Canal Length												
BLOCK C. MAINTENANCE OF FARM DITCHES													
C.1 Status of MFDs 1 - very clean 2 - fairly clean 3 - dirty													
C.2 Status of SFDs 1 - very clean 2 - fairly clean 3 - dirty													
C.3 Status of Laterals 1 - very clean 2 - fairly clean 3 - dirty													
C.4 Status of Main Canals 1 - very clean 2 - fairly clean 3 - dirty													
C.5 Status of Structures													
a. Division Box 1 - damaged 2 - moderately good 3 - in good condition													
b. Steel Gate 1 - damaged 2 - moderately good 3 - in good condition													

	B-LINE DATA	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
c. Foot Bridge 1 - damaged 2 - moderately good 3 - in good condition d. Others 1 - damaged 2 - moderately good 3 - in good condition BLOCK D. FINANCIAL ASPECT D.1 No. of hectares that have paid ISF to date. a. to IA b. to NIA Collector Certified Correct by: ____________ TSA Leader Validated by: ____________ Water Master													

PROBLEMS OBSERVED/ REPORTED BY TSAL

Problems Date ______	Action	Problems Date ______	Action	Problems Date ______	Action
Problems Date ______	Action	Problems Date ______	Action	Problems Date ______	Action
Problems Date ______	Action	Problems Date ______	Action	Problems Date ______	Action

Rivercourse Irrigation Systems Inventory (RISI): An Experience from West Sumatra, Indonesia

Sjofjan Asnawi and Helmi[14]

INTRODUCTION

The increasing concern about the performance of irrigation projects has increased the need for better project plans and designs. Many irrigation projects do not perform as planned because of the failure to take socio-technical aspect into account in the planning phase. Improving irrigation project planning requires the availability of information related to irrigation system development. Rivercourse irrigation systems inventory (RISI) is seen as one of the alternatives to provide adequate information for irrigation development planning.

In the province of West Sumatra, Indonesia, the irrigation systems inventory has been done since 1986. The inventory focuses on providing information about irrigation systems along rivercourses. The rivercourse was chosen as a basis for doing inventory for two reasons. First, West Sumatra is a hilly/mountainous area. The topographic situation limits the area that could be irrigated by any particular irrigation systems. Therefore, small-scale irrigation systems will continue to play a major role in future irrigation system development. Second, intersystem linkages arise when multiple system use water from the same source. Therefore, availability of information regarding irrigation systems along a particular river will help improve intersystem water allocation and distribution.

The RISI in West Sumatra consists of five main activities, namely: (1) preparation (including training for field staff and acquisition of maps), (2) interview, (3) walkthrough along the river, (4) system irrigated area estimation and (5) data processing and presentation. There are four forms of RISI results: (a) rivercourse schema, (b) weir dispersion location on topographic map, (c) schematic presentation of the weirs along a particular river and (d) matrix presentation of information on irrigation systems.

The inventory data are currently used for planning provincial government assistance for village irrigation systems. In the long run the data could be used as basic information for planning government assistance to avoid any negative impact on inter-system water distribution and to establish water right policy and regulations.

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THE EMERGING IDEA OF RIVERCOURSE INVENTORY

A series of research activities by Andalas University on the management of irrigation has been undertaken in the province of West Sumatra, Indonesia since 1982. The research has been undertaken to understand the dynamics of irrigation systems management and the impact of government assistance on traditional farmer-managed irrigation systems. The second research project in 1984 aimed to compare the dynamics of the management of several systems located in the upstream, midstream and downstream of a particular rivercourse. In undertaking the research, a pair of sample systems were selected from each location (upstream, midstream and downstream). The sample systems were also representative of the two groups of irrigation systems, namely those that have received assistance from the government and those that did not receive any assistance (traditional farmer-managed irrigation system).

In the effort to select the sample systems, secondary data from the provincial irrigation service and its branch office in the district level were gathered. When it came to choose the sample systems there were difficulties in finding a pair of a government assisted system and a farmer-managed irrigation system in each location. This was because, based on secondary data, the number of farmer-managed irrigation systems that had not received any assistance was limited. On the other hand, interviews with the farmers and field observation indicated that the number of FMIS must be more than the available recorded data. The researchers at that time agreed to do an inventory along selected river in the research site. Therefore, the objective of the first inventory was to select the research site.

With the gained knowledge on the dynamics of system management, the researchers realized that there is a broader need for doing and inventory for purposes other than just site selection for research purposes. First, intersystem linkages in using water from the same source existed. Therefore, knowing all the systems drawing water from the same source would be helpful in improving coordination in distributing water among the irrigation systems. Second, government assistance to a particular system has negative impacts on the traditional arrangement among the systems in using water from the same river because the government did not recognize the existence of other systems outside their record. With the inventory data, the government would have a basis for planning and implementing a stronger assistance to small-scale irrigation systems.

THE DEVELOPMENT OF THE RISI METHODOLOGY IN WEST SUMATRA

Learning to be Effective

When this issue was brought to the provincial irrigation service, this agency recognized the importance of doing rivercourse irrigation systems inventory in West Sumatra. The main reasons were as follows:

> First, the West Sumatra province is a hilly/mountainous area. The topographic situation limits the area that could be irrigated by any particular irrigation system. Therefore, along a particular river, a large number of small irrigation

systems can be found. A case in point is the Tampo River in the District of Tanah Danar which is 32 km in length and flows from an area of about 1,000 meters above sea level down to 183 meters above sea level. It has 65 irrigation systems located in the middle portion of the river which is only about 19.5 kilometers in length. It shows a 3.3 density of irrigation offtake per kilometer length of the river. The high density of irrigation offtakes along a particular rivercourse requires careful planning to maintain or improve the performance of the systems.

Second, the physical environment of the irrigation systems as explained above also exerts some influence on irrigation system management. This, in turn, affects the institutional arrangements of intersystem water distribution. Planning an intervention to develop a single irrigation system needs to take the whole network into account. Therefore, knowing the configuration of irrigation systems existing along a river course would help to improve the efficiency and equity of water used from the same source.

In short, the irrigation system inventory along the rivercourse aimed to generate information on both the physical and social conditions of irrigation systems. The information would be used to support irrigation systems development and to improve its management in the future.

In the effort to develop the RISI methodology and to give its researchers fresh experience in how to undertake the inventory, Andalas University spearheaded an inventory of irrigation systems. The activities started with a small workshop which was attended by the researchers. The objective of the workshop was to develop a framework for inventory activities and discuss in detail the techniques and equipment. From the workshop, the researcher realized that at least three types of skills and equipment have to be obtained, namely: 1) the skill to read topographic maps and the availability of the maps preferably with the scale of 1:20.000 or less; 2) interview skill and the interview instrument; 3) walkthrough skill and the walkthrough equipment; 4) the skill of estimating the command area by using simple equipment; and 5) the skill of making simple maps and schemas for reporting.

Based on the skills needed, it appeared that training was an important element in the inventory activities. Consequently, training materials were prepared in line with the agreement between Andalas University and the Directorate of Irrigation I (DOI I) in preparation for a pilot inventory.

It was agreed that the pilot activity would cover an area under the jurisdiction of Batusangkar District Irrigation Service. Since the main intention of the pilot inventory was to develop the RISI methodology, the researchers from Andalas University played a major role. The staff of Batusangkar District Irrigation Service were also involved in the field data collection. They were trained prior to the actual collection of field data. Based on the experiences and results of the pilot activities, a book on RISI methodology was prepared which was used for the next RISI activities in different districts.

Learning to be Efficient

As mentioned above, the first ISI undertaken as a pilot project in the Batusangkar District Irrigation Service was in fiscal year 1986/1987. This activity was then continued in the Payakumbuh District Irrigation Service in fiscal year 1989/1990.

There is an important difference between the RISI undertaken in Batusangkar District and in Payakumbuh District. The objective of the RISI activity in Batusangkar District was to develop the RISI methodology, therefore, researchers from Andalas University played a major role in undertaking this activity. On the other hand, the RISI in the Payakumbuh District aimed to develop the capacity of the agency staff to do RISI on their own. As such, the involvement of the researchers from Andalas University in the latter was limited to training, monitoring and providing guidance while the major roles in field data collection and data processing were carried out by the staff of the District Irrigation Service.

The following are some interesting experiences with regard to the second phase of the RISI activities:

1) Field staff felt that their involvement in RISI improved their familiarity with their own area of jurisdiction. This in turn enabled them to perform their tasks better.

2) Since RISI was only one of the several activities that have to be handled by the field staff, the longer time taken for them to conduct the RISI would help ensure better quality of data collected.

THE CONDUCT OF RISI

As mentioned above, there were five main activities in RISI: preparation (including training) and acquisition of maps, interview, walkthrough along the river, system irrigated area estimation and data processing and report writing.

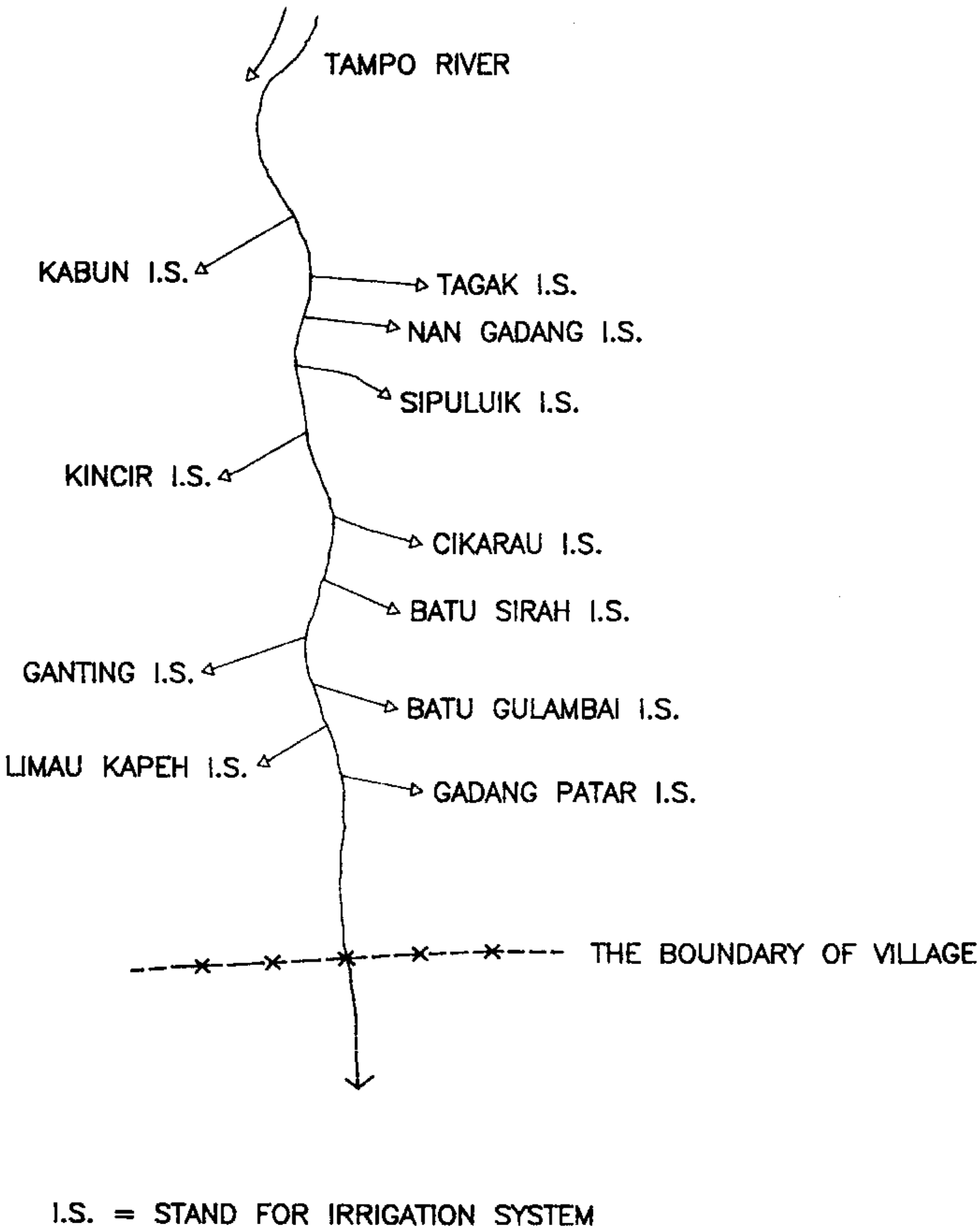
1. In the preparation of the maps, the equipment needed were first made available. Then the maps were surveyed to determine the length of the river and establish local administrative boundaries. Based on the information available from the maps, initial RISI workplan was made.

2. Field interviews were basically done based on village boundaries. Key informants, who have knowledge of irrigation systems were interviewed to get technical as well as social information on the systems located in the particular village. A rough sketch map of the systems along a portion of a river which traverse through the village was then prepared (see Figure 1).

3. To validate the results of the interview, a walkthrough was done. The walkthrough also aimed at plotting the weir position on the topographic map.

4. The fourth activity is the estimation of the irrigated area for each irrigation system in a village (nagari) or a community with smaller coverage. The estimation was facilitated by the key informant who made a list of the command area of the systems in the village which reflected the ranking of the command area based on their relative size. The estimation of the command area was done in the form of a proportion by comparing the command area of each system to any system whose command area was known to the key informant. The researchers themselves, then, measured the area of the system by converting the proportion form into hectarage with the aide of simple equipment e.g. compass and meter band. This information was thought to be helpful in planning water use in a particular area.

Figure 1. Rough sketch map of a portion of Tampo River in Batu Bulek Village



THE RESULT OF RISL

The series of activities mentioned above were done in all rivercourses and the result is presented in several forms: (1) rivercourse schema; (2) the weir location dispersion on topographic maps; (3) schematic presentation of the weirs along a particular river; and (4) matrix presentation of information on irrigation systems. The rivercourse schema contains the name of the rivers, direction of flow, and code number of each river (see Figure 2). The weir location dispersion show the direction of water diversion from the river, the ricefield served by the systems, administrative boundaries, settlement areas, roads and other natural marks like lake, hills, etc. (see Figure 3). The schematic presentation of the weirs along a particular river show the direction of diversion, the name of each irrigation system, code number, area served and distances among the weirs along the river (see Figure 4).

The matrix of information contains code numbers of the system, system name, management status of the system, name of village and subdistrict where the weir is located, type and construction of weir/flushing gate intake, the width of the river at the weir location, percentage of ricefield irrigated in dry season, hydrological linkages in using water from the river with other irrigation systems upstream and/or downstream, intersystems conflict, possibility for area expansion, the name of water user organization and key informants for a particular system (see Figure 5).

Figure 2. The rivercourse scheme

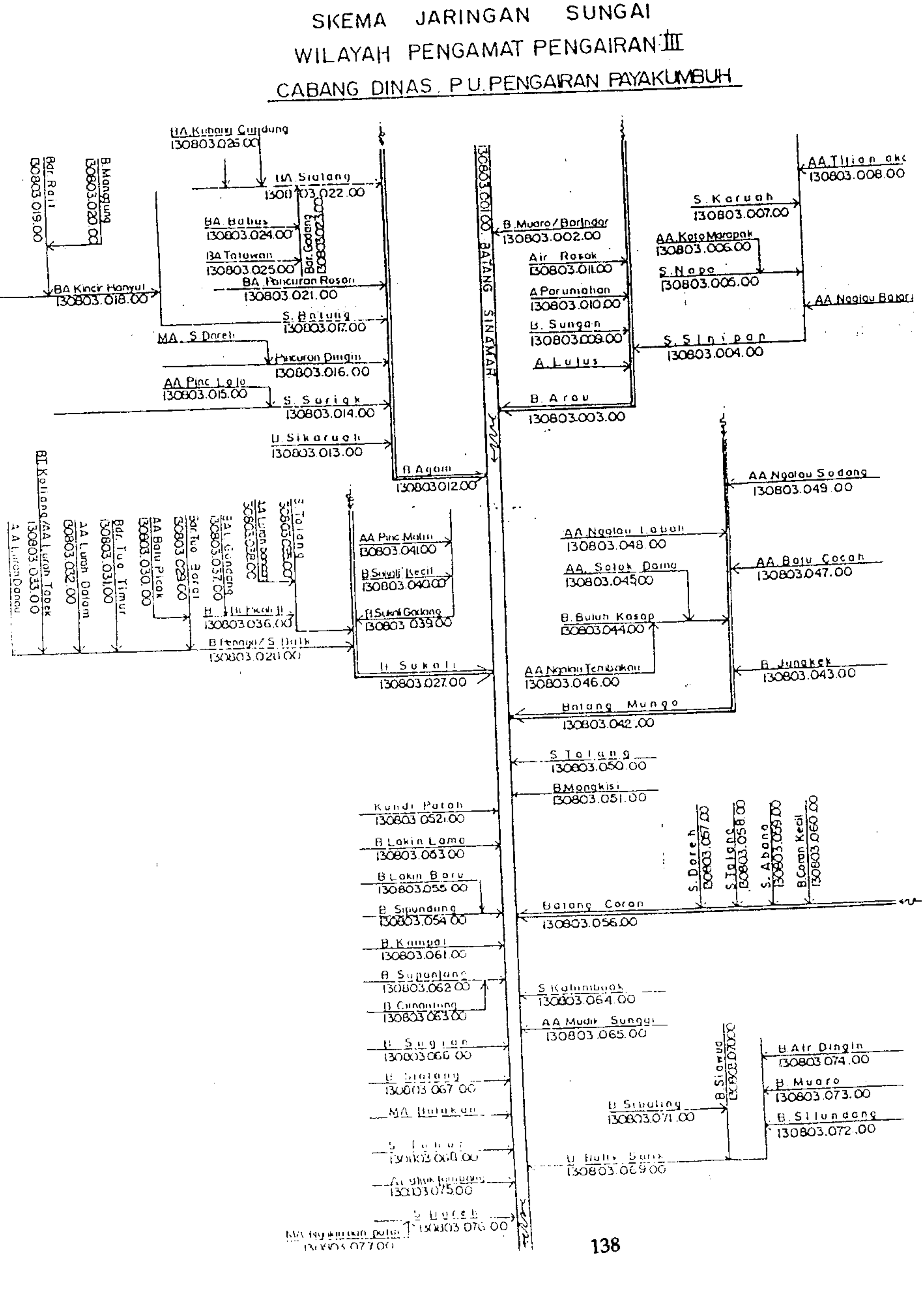


Figure 3. The weir location dispersion on topographic map

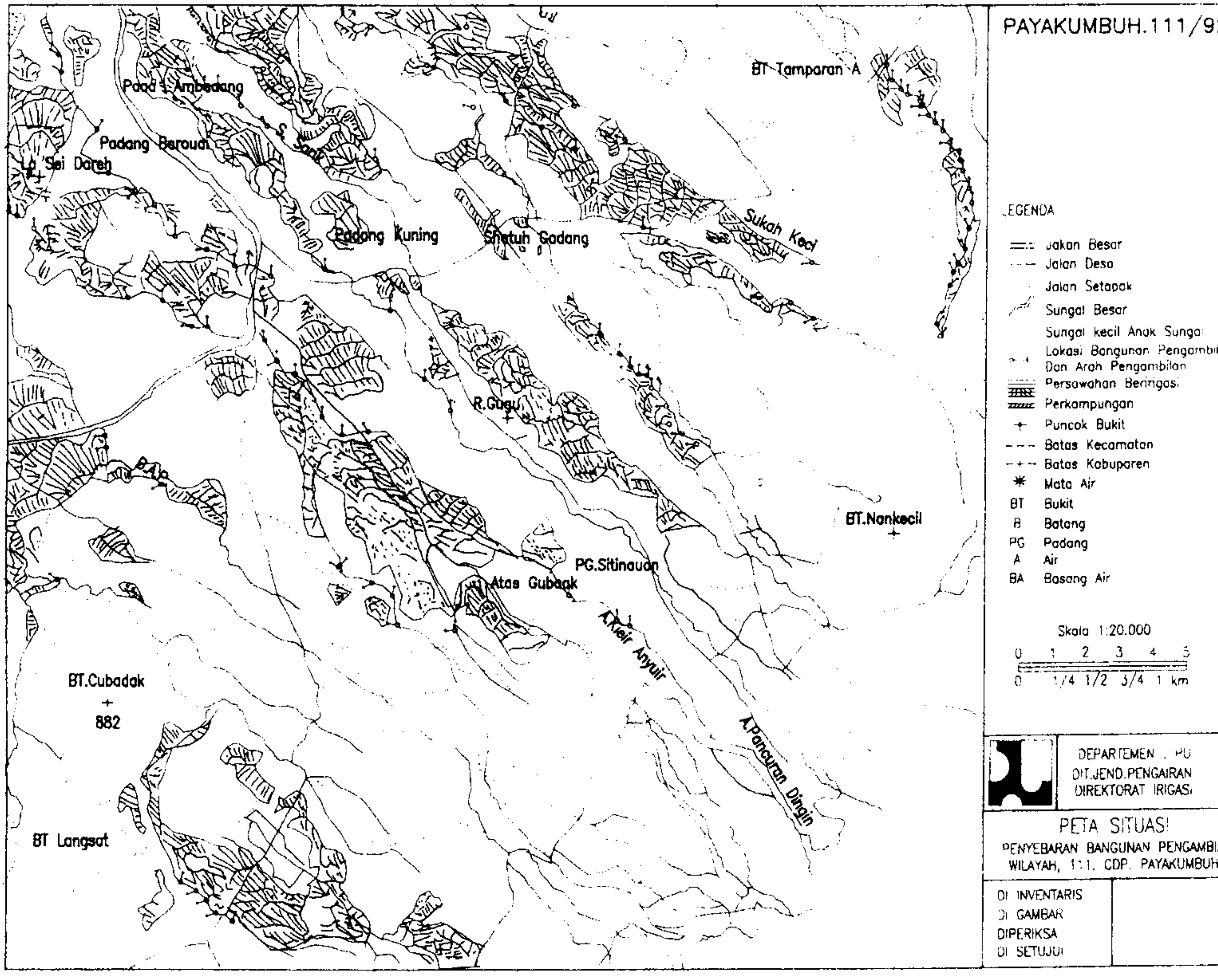


Figure 4. Schematic presentation of the weir along a particular river

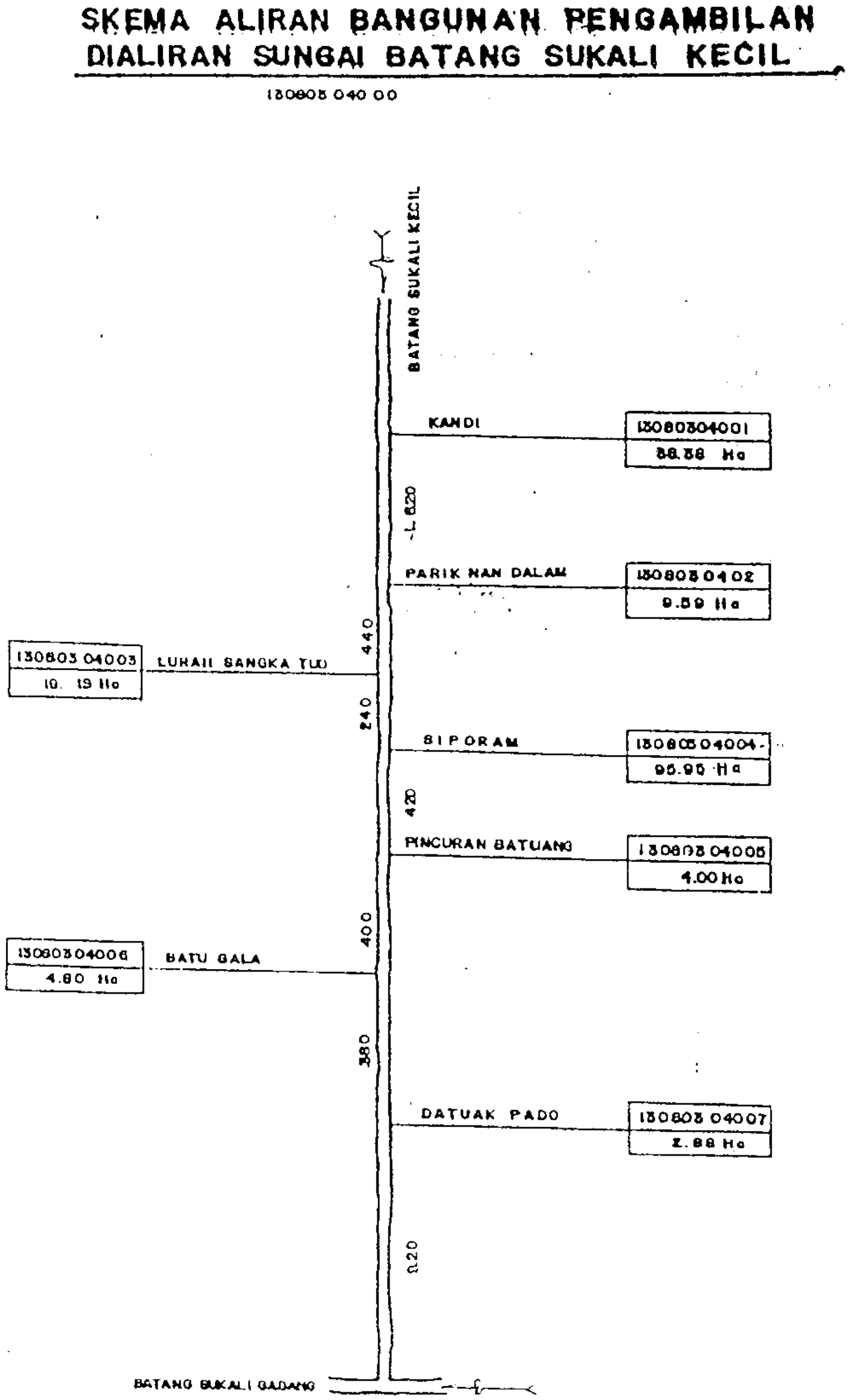


Figure 5. Matrix presentation of irrigation system information along a particular river

MATRIK DAERAH IRIGASI DI ALIRAN SUNGAI B. SUKALI KECIL

WILAYAH PENGAMAT III CABANG DINAS PU PENGAIRAN PAYAKUMBUH

13080304000

Nomor Kode	Nama DI	Klasifikasi		Bangunan Pengambilan								
		PU	Desa	Lokasi Pengambilan Desa / Kecamatan	Peninggi Muka Air: Jenis	Peninggi Muka Air: Konstruksi	Penguras: Dengan/Tanpa Pintu	Penguras: Konstruksi	Intake: Dengan/Tanpa Pintu	Intake: Konstruksi	Lebar Sungai (m)
1	2	3	4	5	6	7	8	9	10	11	12
13080304001	K a n d i		x	Situjuh Gadang / Kec.Luhak	Peliritan	Batu susun	Tidak ada	0	Tanpa Pintu	Tanah	2.6
13080304002	Parak Nan Dalam		x	Situjuh Gadang/Luhak	Peliritan	Batu susun	Tidak ada	0	Tanpa Pintu	Tanah	2.7
13080304003	Lurah Sangka Duo		x	Situjuh Gadang/Luhak	Peliritan	Batu susun	Tidak ada	0	Tanpa Pintu	Tanah	2.9
13080304004	S i p o r a m		x	Bulakan Tinggi/Luhak	Peliritan	Batu susun	Tidak ada	0	Tanpa Pintu	Tanah	2.8
13080304005	Pincuran Batuang		x	Bulakan Tinggi/Luhak	Peliritan	Batu susun	Tidak ada	0	Tanpa Pintu	Tanah	3.5
13080304006	Batu Gala		x	Bulakan Tinggi/Luhak	Peliritan	Batu susun	Tidak ada	0	Tanpa Pintu	Tanah	3.7
13080304007	Datuak Padu		x	Situjuh Gadang/Luhak	Peliritan	Batu susun	Tidak ada	0	Tanpa Pintu	Tanah	3.5

13080304000

Nomor Kode	S a w a h					Hubungan Koordinasi dg.DI lain				Konflik		Kemungkinan perluasan areal	P e n g e l o l a		Keterangan
	Desa / Kecamatan	Luas sawah (Ha)	Pola Tanam	Intensitas tanam padi	% sawah terairi pd musim Kemarau	Pemakai Air		Pemeliharaan							
						Hulu	Hilir	Hulu	Hilir	Dalam DI	Antar DI		Nama/Organisasi pengelola	Nama Key Informan	
1	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
13080304001	Situjuh Gadang / Kec.Luhak	38.32	Padi-padi	1.35	35	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	0	Masyarakat	Dt.Maro Itam	
13080304002	Situjuh Gadang/Luhak	9.59	Padi-padi	1.33	33	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	0	Masyarakat	Dt.Mangkuto Nan Panjang	
13080304003	Situjuh Gadang/Luhak	19.19	Padi-padi	1.65	65	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	0	Masyarakat	Dt. Katu	
13080304004	Bulakan Tinggi/Luhak	95.95	Padi-padi	1.37	37	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	0	Masyarakat	Dt. Bandaro Panjang	
13080304005	Bulakan Tinggi/Luhak	4.8	Padi-padi	2.5	100	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	0	Masyarakat	Dt.Rajo Adil	
13080304006	Bulakan Tinggi/Luhak	4.8	Padi-padi	2.5	100	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	0	Masyarakat	Dauri	
13080304007	Situjuh Gadang/Luhak	2.83	Padi-padi	2.5	100	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	Tdk Ada	0	Masyarakat	Dt.Pado	

The selected data of the inventory results both from Batusangkar District and Payakumbuh District are presented in Table 1.

Table 1. Selected data of inventory results from Batusangkar District and Payakumbuh District

NO.	TYPE OF DATA	BATUSANGKAR DISTRICT	PAYAKUMBUH DISTRICT	TOTAL
1	Number of river	189	321	510
2	Total length of the river (km)	1,062	1,158	2,220
3	Total number of irrigation systems > GMIS > FMIS	2,413 128 2,085	2,202* 86 1,614	4,615 214
4	Average length of the river (km)	5.62	3.61	4.35
5	The average number of irrigation system per river.	12.77	6.86	9.05
6	The density of irrigation system per kilometer length of the river.	2.27	1.90	2.08
7	Total area served (ha.)	26,874	24,870	

Source: PSI-Unand (1988) and PSI-Unand (1991)

* include 502 waterwheel

The main difference of the RISI findings with the government record is the number of farmer-managed irrigation systems. The record of the district irrigation service shows about 50 to 100 fewer FMIS than the RISI findings.

THE USE OF THE DATA

The inventory data are currently used for the purpose of implementation of the Governor Assistance Program for village irrigation systems in West Sumatra. For the long term, the data could be used as basic information for at least two purposes: (1) for planning assistance to the irrigation systems; and (2) for developing a policy and regulations on water rights.

1. *Planning Assistance to Irrigation Systems.* As mentioned earlier, government assistance programs which focus only on individual systems has caused negative impacts on intersystem water distribution. Inventory data give initial information on the possible impact of the assistance to individual irrigation systems.

2 *Developing a Policy and Regulation on Water Right.* As the availability of water becomes scarce and the demand for water for various uses increases, conflict over water use from the source would consequently rise. In order to overcome conflicts over water use, there is a need to establish water right regulations. The inventory data provides information on how the water from the source is currently being tapped, as input to the formulation of policies and regulations on water rights.

CONCLUDING REMARKS

This paper has discussed the development and use of the RISI methodology in West Sumatra. Since little attention has been given in the past to the availability of basic information for irrigation system development planning, there is a need to develop and improve the methodology the meet such information needs. The RISI methodology in its present form still needs improvement to meet the specific data need for irrigation development planning. We hope that it can contribute in enriching the available methodology forconducting irrigation system inventories.

Inventory of Irrigation Systems: Notes from Bali, Indonesia

I Gde Pitana[15]

INTRODUCTION

An inventory of irrigation systems has been conducted in Bali. The objectives of the activity were two fold. Firstly, to describe social-institutional and physical characteristics of the irrigation systems. This can be used as basic information for further development and management planning of irrigation systems. Secondly, the activity was also expected to produce a tested method on inventorying irrigation systems in Bali, which could later be used by government agencies to conduct irrigation system inventories.

Three regencies were selected for the first round of the inventory, namely Gianyar, Badung and Tabanan regencies.

The inventory obtained several basic data which differed from available secondary data. This paper discuss some of the findings and lessons learned in undertaking the said inventory.

In line with the efforts of the Indonesian government to achieve self-sufficiency in rice (rice being the staple food of its population), extensification and intensification of rice production has been a priority program for national development. Irrigation development has been a priority investment area. Massive irrigation projects have been carried out, both for rehabilitation of existing irrigation systems and construction of new ones.

In Bali, irrigation development focussed on rehabilitation of existing irrigation systems, because of limited land available for extensification. Rehabilitation efforts ranged from a single system, to the merger of a number of small-scale systems into one bigger system.

Despite its significant role in increasing rice production, government intervention in the Balinese traditional irrigation systems has been severely criticized because it created negative impacts (Sutawan et al. 1987; Sutawan 1984; and Pitana 1989). Such were caused by the lack of basic data on the irrigation systems being assisted, especially socio-cultural and institutional data about the nature of irrigation systems along river courses and the nature of "*irrigation networks*" along a river basin.

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15 Lecturer, Department of Socio-Economics, Faculty of Agriculture, Udayana University, Densapar, Indonesia. The author thanks Prof. Dr. N. Sutawan for his continuous guidance and the Ford Foundation, Jakarta for which made the presentation of this paper in the workshop possible.

THE NEED FOR INVENTORY

Although traditional irrigation systems in Bali (the so-called *subak*) have long been intensively studied, the nature of inter-subak coordination along a river basin is still not comprehensively understood. This is because previous studies focussed mostly on individual systems. Due to the density and topography of Bali, one can not clearly understand a system without understanding the coordination or network of the systems along a river. The water distribution system employed is highly influenced by upstream systems. In Bali for instance, the *"water borrowing system or rotation"* exists and plays an important role in the water distribution scheme.

Available data regarding irrigation systems along rivers in Bali is inconsistent, and is worst at the provincial level. For example, different sources of data report different numbers of subak. According to the Provincial Office of Public Works (DPUP), the number of subak in Bali is 1,733 with 100,430 ha service area; according to the Office of Agricultural Service (Distan Tanaman Pangan), there are 1,235 subak covering 93,000 ha. While the Provincial Office of Internal Revenue (Dispenda) records the number of subak at 1,274. This implies the inconsistency and unreliability of other data which could be even worse in some cases. Hence, they are very weak basis for development planning. In view of this, making inventories of irrigation systems in Bali is considered an immediate need.

Moreover, inventory of irrigation systems in Bali is deemed very important for the following reasons:

1. It would provide general descriptions of irrigation systems along a river (including their system of coordination with one another);
2. It would provide direction for the "outsiders", (including the government) in prioritizing development needs;
3. It would provide the government with a basis for defining a more feasible management scheme, whether the system will be managed by the government, fully managed by the farmers or a joint management scheme; and
4. It would be able to provide information as to the preliminary activities that must be done prior to the turnover process.

OBJECTIVES

Based on the above-mentioned expected benefits, the objectives of the inventory were:

1. To obtain a profile of the physical characteristics of each single system in the area covered by the inventory such as:

   a. the primary and secondary source(s) of irrigation water (spring, river, or both);

b. location of the weir(s) and location of the area covered, i.e. geographic location relative to others, location along the river (upstream, midstream, or downstream), administrative location (village, district, etc.);

c. the size of the service area;

d. physical status of the systems (weir, canal, division structures, etc.);

e. water sufficiency; and

f. cropping patterns and cropping intensity.

2. To obtain a profile of the social-institutional aspects of the systems, to include:

a. number of water users' association (subak) using the system and their leaders;

b. number of farmers; and

c. the existence of intersubak coordinating bodies (subak-gede).

3. To identify the present management status of the system, whether they are managed solely by the government, by the farmers, or jointly by the government and the farmers; and

4. To describe the relationship/coordination of systems along a river course.

It is noteworthy that aside from the above mentioned objectives, the inventory was also intended to develop methods of conducting an irrigation inventory in a Balinese setting which could later be used by government agencies.

METHODS

Methods used in doing this inventory were basically a combination (and modification) of methods introduced by Romana (1985), Andalas (1988) and Pitana (1989). The methodology consists of: 1) secondary data collection 2) walk through and observations and 3) interviews. For these, observation and interview guides were developed. It is worthwhile noting that the inventory was started from the end of the downstream of the river moving upward. The assumption was that the farmers in the downstream generally had more knowledge about the upstream systems than the other way round. This knowledge is considered very useful, especially in exploring the coordination between adjacent systems.

The results of the inventory were presented in matrixes of individual systems together with a description of a system along a river course.

For the first round, the inventory was conducted in three regencies (out of 8 regencies) in Bali, that is, Tabanan, Badung, and Gianyar regencies.

RESULTS

It was found that there were considerable differences between the data produced by this inventory and those available in government agencies. The number of irrigation systems found in the inventory was much higher than that of government figures. It was found that in the regencies of Tabanan, Badung and Gianyar, the number of irrigation systems were 459, 93, and 136 respectively, which were higher than DPU records (142, 20 and 112, respectively). On the other hand, the area of riceland was found to be smaller. Comparison of the selected data produced from the inventory with those of DPUP for the three regencies aggregatively can be seen in Table 1.

Table 1. Comparison Between Data of DPUP and the Results of the Inventory

No.	VARIABLE	DPUP(*)	INVENTORY
1	Number of Irrigation System	274	688
2	Number of Subak	763	1.147
3	Riceland (ha)	63,123.07	60.367,85
4	Number of Weir	n.d.	696
	a. Gov't Rehabilitated Weir	140	168
	b. Traditional(farmer's)**	n.d.	528
5	Number of Subak Gede	n.d.	96

Notes:
* Analysed from "Buku Pintar DPUP 1989"
** Including spring without weir structure
n.d. no data

LESSONS LEARNED

The difference in the number of irrigation systems found by the present inventory from that of DPUP was due to the varying definitions used. In defining an *"irrigation system"*, DPUP follows the unit of *"irrigation development project"*. One irrigation project sometimes consists of several small-scale systems, which were individually rehabilitated. Even without any physical connecting one to another, DPUP, insists on counting the rehabilitated systems as one irrigation system. On the other hand, this inventory defines an irrigation system based on Government

Regulation (PP) No. 23/1982, which mentions that *"irrigation system is a complex of ricefield getting irrigation water from a single irrigation network"*. Hence, one system in DPUP records often consists of more than one system as found in the inventory.

The difference in the number of subak was also complicated by the difficulty of identifying a subak in the field. It seemed that DPUP was inconsistent in defining what a subak is. In addition, the farmers often interchange the terms subak, tempek (sub-subak) and subak-gede (which refer to system, sub-system and supra-system levels respectively).

As to the area irrigated, the different figures might have been caused by one or more of the following factors: 1) newly expanded riceland could not be recorded during the field work; 2) in some cases, the size of the ricefield was purposely overestimated to qualify the small-scale systems for government assistance because there was a rule that a system can only be rehabilitated by the government if its size is more than 150 ha; 3) for the newly rehabilitated projects where the riceland had not yet been expanded, DPUP had recorded the planned expansion areas as actual areas and 4) in some irrigation systems, the area of the riceland had been reduced (converted into other uses such as clove, grave, or vanilla plantation as well as for non-agricultural uses), but DPUP records still reflects the riceland area before the conversion.

This inventory also discovered that a lot of irrigation systems used by several subak have not yet developed a coordinating body (*subak-gede*). Each subak independently concentrates in their own areas, while operation and maintenance of the main system is the responsibility of the government (DPUP). If these systems are to be turned over to the farmers, it is recommended that the organization covering the system as a whole be strengthened (namely, the formation of *subak-gede*). In the systems where *subak-gede* have been in operation, the government should strengthen their management capability.

For small-scale systems which are considered single systems by DPUP, it is recommended that if the government should define its position as to whether it will turn over the management of the systems to the farmers.

Since this inventory has revealed a number of significant results, it is deemed necessary that it be continued to cover the other five regencies (Jembrana, Buleleng, Karangasem, klungkung and Bangli). It is recommended that the methods developed by this inventory be used to guide the collection of consistent and reliable information.

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Regulation (PP) No. 23/1982, which mentions that *"irrigation system is a complex of ricefield getting irrigation water from a single irrigation network"*. Hence, one system in DPUP records often consists of more than one system as found in the inventory.

The difference in the number of subak was also complicated by the difficulty of identifying a subak in the field. It seemed that DPUP was inconsistent in defining what a subak is. In addition, the farmers often interchange the terms subak, tempek (sub-subak) and subak-gede (which refer to system, sub-system and supra-system levels respectively).

As to the area irrigated, the different figures might have been caused by one or more of the following factors: 1) newly expanded riceland could not be recorded during the field work; 2) in some cases, the size of the ricefield was purposely overestimated to qualify the small-scale systems for government assistance because there was a rule that a system can only be rehabilitated by the government if its size is more than 150 ha; 3) for the newly rehabilitated projects where the riceland had not yet been expanded, DPUP had recorded the planned expansion areas as actual areas and 4) in some irrigation systems, the area of the riceland had been reduced (converted into other uses such as clove, grave, or vanilla plantation as well as for non-agricultural uses), but DPUP records still reflects the riceland area before the conversion.

This inventory also discovered that a lot of irrigation systems used by several subak have not yet developed a coordinating body (*subak-gede*). Each subak independently concentrates in their own areas, while operation and maintenance of the main system is the responsibility of the government (DPUP). If these systems are to be turned over to the farmers, it is recommended that the organization covering the system as a whole be strengthened (namely, the formation of *subak-gede*). In the systems where *subak-gede* have been in operation, the government should strengthen their management capability.

For small-scale systems which are considered single systems by DPUP, it is recommended that if the government should define its position as to whether it will turn over the management of the systems to the farmers.

Since this inventory has revealed a number of significant results, it is deemed necessary that it be continued to cover the other five regencies (Jembrana, Buleleng, Karangasem, klungkung and Bangli). It is recommended that the methods developed by this inventory be used to guide the collection of consistent and reliable information.

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MATRIX A. IDENTIFICATION OF IRRIGATION SYSTEM

No.	CODE OF I.S.	NAME OF I.S.	MANAGE -MENT STATUS	LOCATION OF WEIR		SUPPLE-MENTARY WATER SOURCE	WEIR CONS-TRUCTION	LENGTH OF THE WEIR	DISTANCE OF OTHER WEIR (m)	EXISTENCE OF COORDINATION
				RIVER	VILLAGE					

MATRIX B. IRRIGATION FACILITIES AND COMMAND AREA

NO.	NAME OF I.S.	LENGTH OF MAIN CANAL (Km.)				YEAR OF REHABILITATION	RICELAND		
							LOCATION		SIZE (Ha.)
		LINED	EARTHEN	TUNNEL	TOTAL		VILLAGE	DESA ADAT	

MATRIX C. FARMERS' ORGANIZATION

NO.	NAME OF I.S.	NAME OF SUBAK	LOCAL TERMS	NUMBER OF SUB-SUBAK	SERVICE AREA (Ha.)	NUMBER OF MEMBER	NAME AND ADDRESS OF LEADER	REMARKS

MATRIX D. CROPPING PATTERNS AND CROPPING INTENSITY

NO.	NAME OF I.S.	CROPPING PATTERNS	CROPPING INTENSITY		
			RICE	SECONDARY CROPS	TOTAL

Management Information System for Irrigation System Development and Management in Indonesia

Aris Priyanto[16]

INTRODUCTION

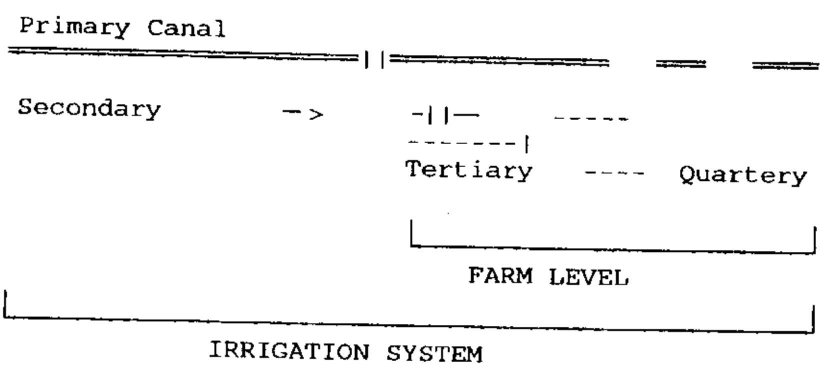
The main objective of an information system is to create a database which can be analyzed for certain purposes and it is obvious that this system will make irrigation system development and management planning easier, more effective and efficient. But to develop an effective Management Information System (MIS), especially for irrigation system development and management in Indonesia, a number of factors may have to be considered. First, Indonesia consists of thousands of islands, divided into 27 provinces and each has different infrastructure condition and communication facilities. Second, there are two irrigation systems namely the Government Irrigation System and the Rural Irrigation System. Third, different institutions are involved in planning, operation and irrigation management, that make information required for planning come from different sources. Fourth, setting up a management information system may need certain efforts and budgeting to make available the required hardware and software. There may also be a need to set up an appropriate organization to support the system.

First, a brief background in the irrigation system in Indonesia, its operation and management and its relationship to the agricultural system shall be discussed to provide this paper a better perspective.

Irrigation Network as a System

An irrigation network can be seen as physical structures that make possible conveyance of water from its sources to farm levels, as shown in Figure 1.

Figure 1. Irrigation network as a system



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Irrigation Network as a Subsystem

An irrigation network can also be seen as a subsystem or part of an agricultural system that consists of an irrigation subsystem, a production subsystem and may include a marketing subsystem , as shown on Figure 2.

Figure 2. Irrigation network as a subsystem of agricultural system

```
input >-----------> output        inputs ---------> output

                                   seed->
    Irrigation ->  water           ---- >   Production --> Agric. product
    Subsystem                fertilizer->   Subsystem
                                   etc.->

  |________________________________________________________________|
                           AGRICULTURAL SYSTEM
```

Irrigation Classification

Irrigation Network in Indonesia is divided into government irrigation system and rural irrigation system. Further, government irrigation systems are classified into (1) technical irrigation system (the highest rank), (2) semi-technical and (3) simple irrigation systems or rural irrigation systems "improved" by the Government.

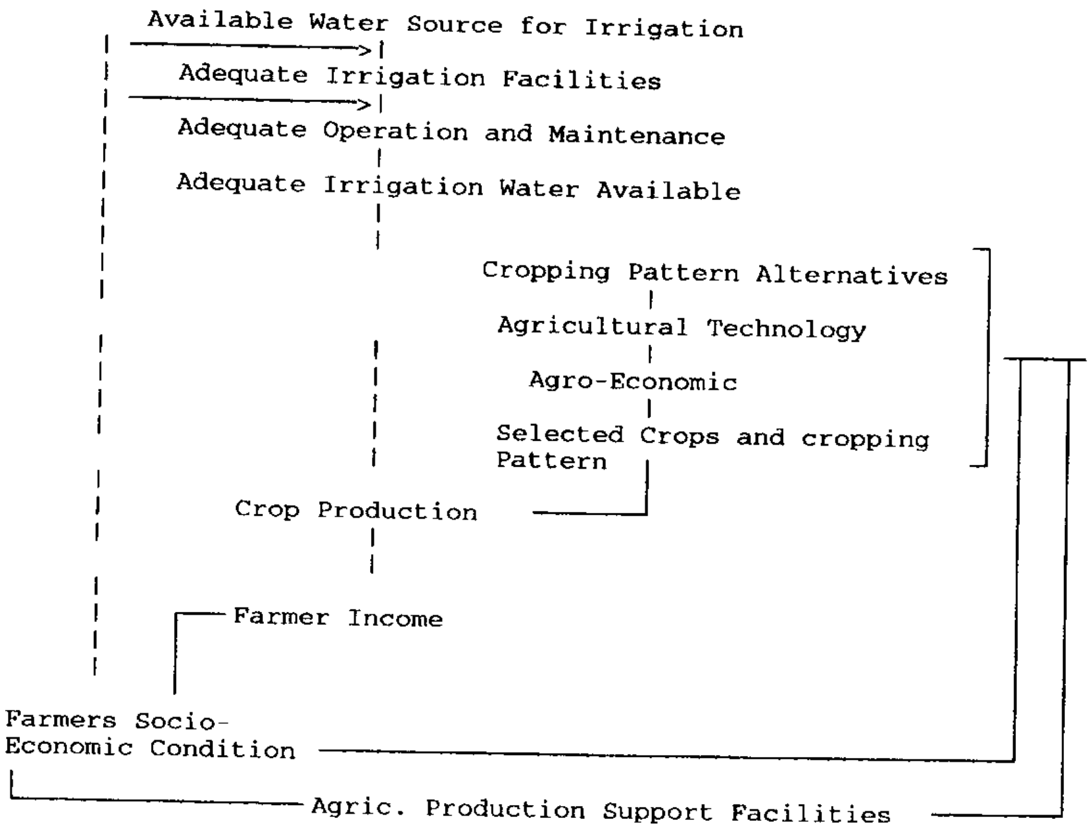
The Ministry of Public Work is responsible for Planning and Design of the whole Government Irrigation System including its construction, operation and maintenance up to secondary system (see Figure 1), while the rest (tertiary to farm level) is handed over to the farmers who are usually helped by the Ministry of Agriculture.

Construction, operation and maintenance of systems are usually done by the farmers, although technical assistance and budgetary aid are sometimes given by the Government, i.e. Ministry of Home Affairs, Ministry of Agriculture and Ministry of Public Work (local agency) or foreign aid.

IRRIGATION SYSTEM PERFORMANCE

Irrigation system performance is determined by the availability of water source for irrigation, the type and condition of the irrigation structures or facilities to convey water from its source to farm level, operation and management of the system, agricultural technology and water use management, socio-economic of the farmers and other agricultural production support facilities. The inter-relationship between these factors is shown in Figure 3.

Figure 3. Factors affecting irrigation system facilities



INSTITUTIONS INVOLVEMENT IN AGRICULTURE AND IRRIGATION MANAGEMENT

In Indonesia, at least there are 3 ministries involved in Agriculture and Irrigation Management in rural areas namely Ministry of Public Work, Ministry of Agriculture and Ministry of Home Affairs. In addition to agricultural inputs supply and marketing a number of agricultural products, credit facilities are also provided through the Ministry of Cooperative and Banking.

According to the governmental organization or structure, each ministry has his own agency down to subdistrict level (Central Government, Provincial Level, District Level and Subdistrict Level), except the Ministry of Home Affairs which serves up to the village level. Beside sectoral ministries, there are also the National Development Planning Board at Central Government Level, Development Planning Board, the Provincial and District Level. The Village Government consist of a Village Level Planning Board, but at a more developed village cooperative, key farmers etc. might exist.

As experienced by the institutions involved in agriculture and irrigation system as mentioned earlier, in order to collect data or information for management information system development, there is a need to establish the level and kind of information to be collected and in which institution the required data might be available. Collecting data for irrigation development or improvement is not so easy. It depends on the local administration and extent of coordination between institutions.

MANAGEMENT INFORMATION SYSTEM DEVELOPMENT

Scarcity of data is common in a developing country, and yet quite a lot of data and information are routinely generated. An information system through which these data/information are gathered, stored, retrieved, processed and used for planning or decision making. Information is an output from input data. It has been mentioned that there are various levels at which these data are gathered. At the grassroot level, it could be about individuals or individual families/households or about individual plots of land. At a higher level, at subdistrict level for example, it could be about groups of people, tracts of land, school or villages and at district level the collected data may be about land use, population growth, service centers and distribution and road networks.

Most collected data at lower levels are aggregated to larger units, generally by administrative units. This process may lose some of the information. The aggregation of population of villages into a district for example will give only a single figure at district level. The distribution of population among the villages within the district is lost. An agency which collects data for its own use decides what data to collect, in what format to collect them and how to store and process them without reference to other agencies which might also use that data. Consequently those other agencies might find it difficult to use those data.

A detailed irrigation information system may also need a system of multi-level, multi-agency gathering, storing, retrieving, processing and using of data. These various components must be integrated into a system. Most often there is little or no integration or coordination among various components or agencies. Our experience shows that especially for rural irrigation inventory, data gathered at the central government level should be confirmed at provincial and district levels and detailed information may only be available at the village level. This condition emphasizes that an effective conveyance to the higher level agencies, system compiling data, updating and coordination or integration of data gathered by each agency is important. Another kind of information required for planning is the geographic location of the area. In this case, geographic information systems (GIS, Winata et al., 1992), used by different countries might be very helpful in gathering the geographic location and it may also be combined with other information system such as ILWIS (Information of Land and Watershed System, Valenzuela, 1988).

METHODS

Kind and Level of Information

In general, the objective of the irrigation system is to increase farmer welfare by increasing crop production and farmer income. But the achievement of this objective is affected by a number of factors. Management information systems for FMIS that cover various kinds and levels of related information will be helpful in solving FMIS development and assistance problems.

The following are different kinds and levels of information suggested to be covered in a Management Information System for FMIS.

Level 1 — Information at this level describes only the existing irrigation systems and FMIS, establishment and irrigated area, by Province.

Level 2 — This level of information provides deeper information on the location, coverage and establishment of FMIS by Districts/Regencies in the Province.

Level 3 — This level describes more detailed information on FMIS and supporting data.

- i. The existing FMIS by Subdistrict/village
- ii. Water source for FMIS (discharge and distribution)
- iii. Climatological data
- iv. Topography and soil map
- v. Input-output analysis of crop production
- vi. Available supporting facilities for agricultural production and marketing
- vii. FMIS problems and planning

Level 4 — Detailed information of the existing FMIS by village.

- i. Infrastructure of the village.
- ii. Socio-economic data:
  - total inhabitants, education and occupations
  - total farmer households
  - land holdings
  - total farm labor available
  - existing crop types and cropping patterns
  - farm and non-farm income of the villagers
  - existing farmer organizations and activities
  - available agriccultural production facilities (credit, inputs, marketing)
  - agricultural production and marketing problems

iii. Physical data:

- FMIS map
- Irrigation network condition
- Type of water source and availability
- Flood/long dry season, its period and frequency
- FMIS physical problems

iv. Management

- Irrigation water management and problems
- Agricultural technology and management

Data Gathering Network

To set up an FMIS information system, data should be gathered, compiled, organized and updated effectively not only for FMIS inventory, but also to make required FMIS analysis and monitoring easier. A list of FMIS in Indonesia is found in the Annual Report of the Bureau of Statistics, but it is limited to certain specified location and area by province. Further information of FMIS location by district, its establishment and coverage, are usually available at the Ministry of Agriculture. But for more detailed information, the agricultural agency at provincial level and especially at district level are the best sources. Although there are also technical assistance or budget aid from the Ministry of Home Affairs and the Ministry of Public Works, it seems that the Ministry of Agriculture has a closer relationship to and more concern for the FMIS. Therefore, it seems that the Ministry of Agriculture would be appropriate to act as the coordinator of information and work with other related institutions at different levels (central, provincial, district, subdistrict/village) in gathering data, and setting up planning or programs that are related to FMIS.

Data Conveyance

For an effective flow of data and information from the lowest level (village) to central government, responsibility of data collecting and making a number of required analysis related to FMIS should be given to the agricultural agency at the district level in coordination with other institutions. Further, these informations are conveyed to the agricultural agency at the provincial level and the Ministry of Agriculture (Central Government) or directly to the Ministry of Agriculture.

Data Processing and Updating

Processing or analysis of data or information covered in Level 1 and 2 (see point 5a.) are not necessary but it might be required for a number of data at Level 3 and 4 to produce further information for policy and decision making purposes particularly in setting up any assistance programs for FMIS, as shown by the following examples:

i. Information at Level 4 can be analyzed to operate:

   (a) type of solutions required to help FMIS in solving their problems; and
   (b) appropriate planning of any kind of assistance for FMIS.

ii. Information at Level 3 can be used to promote an optimization of the available water and cropping pattern and scheduling based on available water discharge, climatic condition, crop water requirements and also agricultural input-output analysis.

To keep abreast with the fast changes in almost all parts of Indonesia and to maintain the accuracy of the FMIS database, annual data updating might be required.

Management Information System Requirements

An effective MIS needs software and hardware, although it depends on the type of technology that will be applied in the system. Geographic information systems (GIS) for example, have the following elements: computer hardware, computer software, data, personnel to run the system and a set of institutional arrangements to support the system. To develop a management information system for FMIS in Indonesia, effort and budgeting are required to make available hardware, software and set up an appropriate organization to support the system, at least to set up linkages between FMIS information systems of the agricultural agency at the district, provincial and Ministry of Agriculture (Central Government) levels.

CONCLUSION

It is obvious that management information systems of FMIS would be very helpful not only for FMIS inventories but also to improve planning and decision-making for assistance programs for FMIS.

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Inventory of Farmer Managed Irrigation Systems in Indonesia: A Basic Concept

Bayudono[17]

INTRODUCTION

The Government of Indonesia has long been aware of the importance of making inventories of irrigation systems, as stated in several laws and regulation on water resources or irrigation.

Through a programme called "handing-over of small scale irrigation system" the Government of Indonesia intended to turn over the right and responsibility to manage small scale irrigation system to the concerned Water Users Association (WUA). The experiences in implementing the said programme will be the basic reference of this paper.

An irrigation inventory may have great importance as the data and information are the basis for evaluating system performance, preparing irrigation plans, designing rehabilitation and modification works as well as increasing water use efficiency.

Provincial Irrigation Services have the responsibility to undertake inventories of Farmer-Managed Irrigation Systems (FMIS), which to some extent may be done, in cooperation with WUA.

An inventory of FMIS should cover the physical facilities of the system, performance and institutional status of the system. Data taken from the field survey can then be divided into: basic data, periodical data and supplemental data.

At the lowest level, a field survey can be carried out in cooperation with farmers or village officials. The next inventory process can be undertaken by the Irrigation Service at different levels.

Two-stage verification should be applied to the data obtained from survey. However, the other data may be processed further. Computer aided data processing will be very helpful in this regard.

The outputs of such inventories are <u>Inventory Resume, Correction Sheet and Detailed Inventory</u> which should be furnished to appointed institutions.

The inventory process should be on an annual basis, but data collection should follow the irrigation period.

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There are two main beneficiaries of the inventory, firstly, the Irrigation Service and secondly, the WUA.

The total irrigated area in Indonesia is 4,334,654 hectares, out of which some 1,885,742 hectares (43.5%) are covered by 25,304 small scale irrigation systems or the so-called "village irrigation systems" managed by village authority or farmers through Water Users' Association (WUA).

The Government of Indonesia (GOI) has long been aware of the importance of the inventory of irrigation systems. In fact, Article 3 of Law No. 11/1974 on Water Resources states the obligation of the Local Government to make an inventory of irrigation systems inside its administrative boundary, while Article 9 of Government Regulation No. 23/1982 on Irrigation states the need to undertake an inventory of water resources all over the country.

Many inventories of irrigation systems have been made available at regional or lower levels, but there were only two prominent inventory systems that had been established at the national level, for FMIS and government managed irrigation systems (GMIS). Unfortunately, these inventories reflect only the technical and engineering aspects of the irrigation systems studied.

In 1987, the Directorate of Irrigation (DOI) in Indonesia established a programme which specifies that small scale irrigation system formerly managed by the Government would be handed over to WUAs. One of the activities of the programme was the inventory of the irrigation systems. The inventory was used to evaluate the physical condition of the irrigation systems, institutional status of the WUAs and performance level of the system either at the main and the tertiary levels, so that a detailed action plan can be prepared and implemented before handing over the irrigation system and its management responsibility to WUAs.

The inventory experience related to the above mentioned turn over programme is one of the most important reference of this paper.

THE OBJECTIVES OF THE INVENTORY

The main objective of the inventory is to provide detailed data and information on irrigation systems to be used as a data base for evaluating system performance, preparing irrigation plans, designing rehabilitation or modification works, increasing water use efficiency and other planning activities.

IMPLEMENTATION RESPONSIBILITY

As stated in Article 2 Paragraph 2 of the Government Regulation of the Republic of Indonesia No. 23/1982, the rights to manage irrigation water and irrigation networks at the farm level and in village owned irrigation systems or Farmer-Managed Irrigation Systems (FMIS), shall be given to WUA(s) or village authorities, with the assistance from local government authority through the Provincial Irrigation Service.

Based on the government policy, it is clear that the WUAs should be responsible for carrying out the inventory programme of their own irrigation system. Due to their limited skill, knowledge as well as financial resources, the WUA itself seemed not capable of carrying out such an inventory programme. Therefore, the local government through its Irrigation Service implemented the programme and the active participation of the WUAs was one of the conditions of its implementation. Appendix 2 shows the areas of responsibility of the Irrigation Service at different levels in the implementation of the inventory.

It is important to note that there was no need to establish a special operational unit or project to undertake the inventory, since this was part of the duties of the irrigation staff. However, efforts were exerted at the beginning of the programme to collect and manage basic data as a benchmark to the next step in the inventory process.

SCOPE OF INVENTORY

The inventory of the small-scale systems covered three aspects:

a. **Inventory of the physical facilities of the irrigation system.** Through this activity the technical data on all irrigation facilities, i.e. structures, canals and infrastructures were compiled, including their present condition.

b. **Performance of the system.** Consists of records of the streamflow, reliability of the flow, water requirement, water balance, the seasonal irrigated area, level of irrigation efficiency, cropping pattern, cropping intensity, yield and production and other related variables.

c. **Institutional status.** Existing WUA(s), number of members, efficiency of the organization, their financial status and other data which expressed the institutional profile of the WUA.

A comprehensive data compilation will be a great contribution to the users, but the tendency to provide detailed information with broader range of data should be avoided as this will require a large scale inventory activity that needs special efforts, skills, manhours and, most importantly, an adequate budget that may go beyond the capacity of the irrigation service to conduct. Exception is given to the benchmark survey where detailed basic data will be kept as benchmark inventory.

DATA SPECIFICATION

Data taken from an inventory survey can be divided into three types:

a. **Basic data.** All data that will not change within a short period, such as command irrigation area, area of ricefield, technical specification of the headwork, canal and structures. In general, this specification is closely related to technical and engineering data.

b. **Periodical data.** Data that should be renewed in a certain period, for example seasonal cropping area, harvested area, crop yields, cropping intensity and others. Usually, the data are needed to evaluate the performance of the system.

c. **Supplemental data.** Such as hydroclimatological data, streamflow and others. The data can be classified as secondary data and may be obtained from other sources.

DATA COLLECTION

Data is collected through a field survey by means of inventory instruments, such as a questionnaire, inventory sheets etc. The instrument should be of standardized form so that standardized data can be obtained although they are taken from different surveys and/or different for periods. The lowest rank of the Irrigation Service (i.e. Subbranch Irrigation Service, SBRIS, or Irrigation Supervisor) together with the WUA(s) of the irrigation area, are responsible to carry out the field survey. The field survey schedule should be arranged with respect to the schedule of irrigation activities in the field as several data can only be obtained during a certain period of time.

An Inventory Book and Correction Sheet will be produced as the result of the survey, and sent to the higher rank office i.e. branch irrigation service (BRIS). The Inventory Book consists of compiled raw data from the survey, while the Correction Sheet is the verified data from the survey.

A manual of the inventory system is important. This explains the terms, methodology, instruments, procedures, data processing and analysis, distribution of information and others. Inventory objects should be described into several categories according to its complexity and diversity, so that the inventory can be compiled on a systematic file. The procedure should be completed with flowchart as well as barchart.

DATA PROCESSING

Data obtained from the field survey should first be verified, especially with regards to the validity and completeness. Doubtful data should be checked by comparing present correction sheet with the previous one(s), and if it does not give any good result, then those ambiguous data must be resurveyed in the field.

Some data may be processed further, for example cropping area data, together with stream flow and hydroclimatological data which could be used to derive the water requirement and water balance. Estimation of cropping intensity will require data on irrigation command area as well as cropping area.

Data that needs further processing and the expected output are seen in Appendix 3.

FLOW OF DATA PROCESSING

Verified (new) data is used to renew the previous inventory book(s). In case a computer was made available in the BRIS Office to aid the inventory process then all data in the book should be entered to disk(s). A special software designed for the inventory will be very helpful. Otherwise, worksheets using Lotus 123 or other similar software may be applicable. A personal computer with a 20 megabyte hard disk onboard will be preferable. If possible, a MODEM facility can be installed in the computer, but sending a printout or hardcopy seem to be the cheapest way to send the data from BRIS offices to Provincial Irrigation Service (PRIS).

PRIS should verify the data received from BRIS before entering it to higher level data management where a Master File should be available. The available Master File in PRIS Office must be renewed using the new data. Appendix 2 shows the process flowchart for data processing.

INVENTORY OUTPUT AND THE DISTRIBUTION

Besides an Inventory Book for each irrigation area, the inventory activity will produce other outputs. Those are:

1. **Resume of the Inventory of Irrigation Systems**. With the authorization from the Head of the District this document will be returned to the BRIS for filing.

2. **Correction Sheet**. Consists of verified data form the survey shall be returned to SBRIS to be used for the next survey.

3. **Detailed Inventory**. Shall be delivered to each corresponding WUA for filing.

INVENTORY IMPLEMENTATION SCHEDULE

Although the inventory activities may be done annually, data collection should be carried out periodically in accordance with the irrigation activities in the field.

Since the output of the inventory shall be used as inputs for planning irrigation operation and other activities, it is suggested that all inventory output should be issued and delivered before the beginning of the planting season. The tentative schedule for an inventory of a FMIS can be seen in Appendix 4.

UTILIZATION

There are two beneficiaries of the FMIS inventory. Firstly, the Irrigation Service which is responsible to technically assist and promote the activity of WUA(s) in managing the irrigation water at the farm level. Using the inventory, the PRIS would be in a better position to monitor and evaluate the performance of FMIS's. Moreover, any detailed action plan for improving irrigation system performance would may be prepared more easily using inventory results.

Secondly, the WUA(s) themselves which could make use of the inventory to improve the management of the irrigation system in particular irrigation planning, irrigation water distribution schemes, and operation and maintenance of the system.

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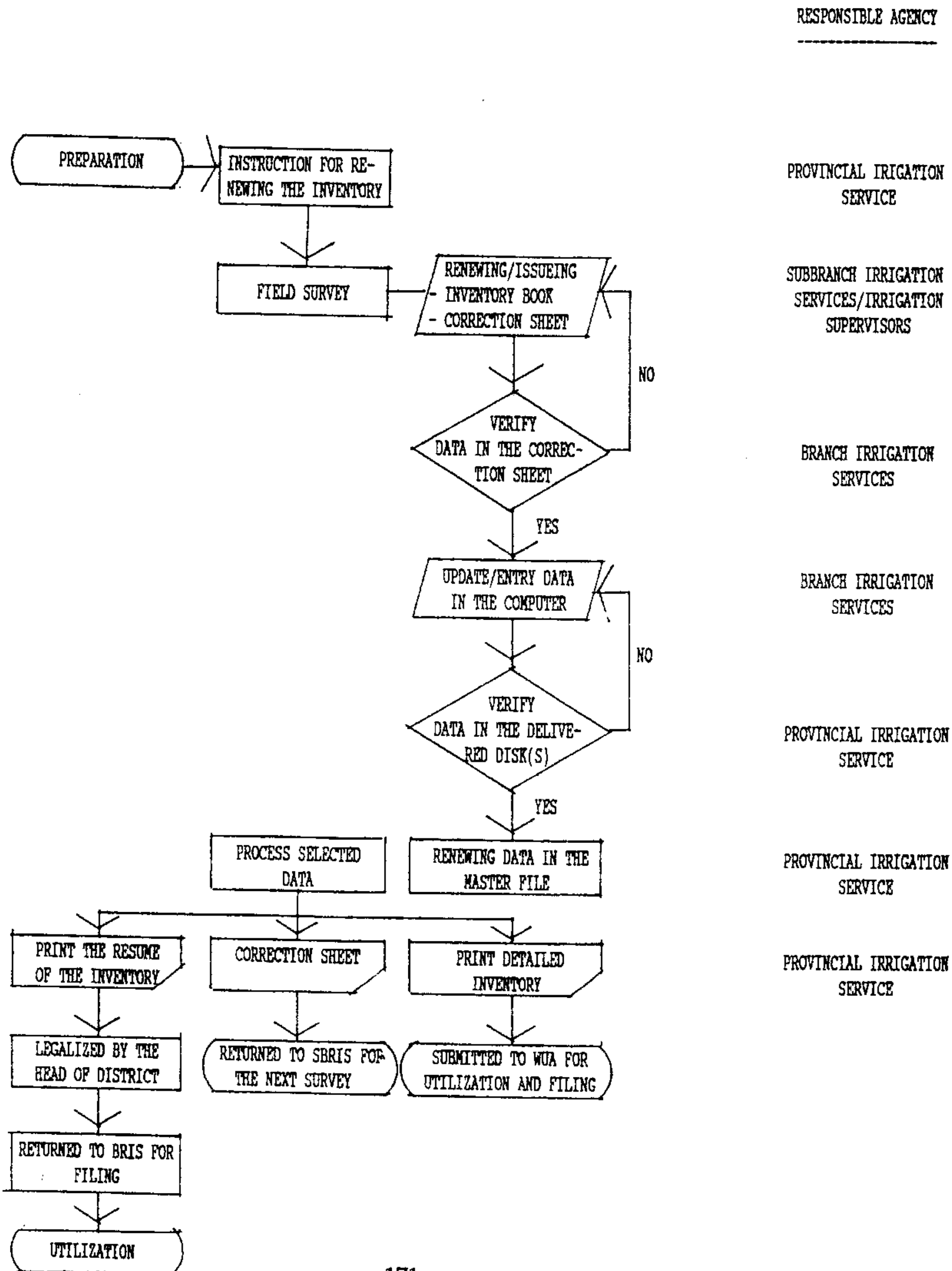
Appendix 1. List of data for the inventory of FMIS

CODE NUMBER	DATA CLASSIFICATION	SPECIFICATION
B.	BASIC DATA	
B.1.		Name of irrigation area.
B.2.		Number of tertiary blocks.
B.3.		Names of tertiary blocks.
B.4.		Command area of each tertiary block.
B.5.		Technical specification of the headwork;
		B.4.a. Type.
		B.4.b. Length of weir.
		B.4.c. Number of intake gates.
		B.4.d. Number of sluice gates.
B.6.		Technical specification of the canal;
		B.5.a. Length of primary canal.
		B.5.b. Length of secondary canal.
		B.5.c. Length of tertiary canal.
		B.5.d. Design capacity of the primary canal.
B.7.		Number of irrigation structures;
		B.7.a. Regulator.
		B.7.b. Turnout.
		B.7.c. Slide spillway.
		B.7.d. Drop structure.
		B.7.e. Check structure.
		B.7.f. Measuring device.
		B.7.g. Culvert.
		B.7.h. Syphon.
		B.7.i. Flume.
B.8.		Drainage system.
		B.8.a. Length of drainage canal/ditch.
		B.8.b. Type and number of structures.
B.9.		Irrigation infrastructure;
		B.9.a. Number of office building.
		B.9.b. Number of staff housing.
		B.9.c. Number of bridges.
		B.9.d. Length of inspection road.

CODE NUMBER	DATA CLASSIFICATION	SPECIFICATION
B.	BASIC DATA	
B.10.		Water Users Association; B.10.a Number of WUA in the irrigation area. B.10.b. Number of WUA member. B.10.c. Availability of by-laws.
P.	PERIODICAL DATA	
P.1.		Wet season cropping area (in ha) P.1.a. Rice. P.1.b. Upland crops.
P.2.		Dry season cropping area (in ha) P.2.a. Rice. P.2.b. Upland crops.
P.3.		Third season cropping area, if any (in ha) P.3.a. Rice. P.3.b. Upland crops.
P.4.		Wet season harvested area (in ha) P.4.a. Rice. P.4.b. Upland crops.
P.5.		Dry season harvested area (in ha) P.5.a. Rice. P.5.b. Upland crops.
P.6.		Third season harvested area, if any (in ha) P.6.a. Rice. P.6.b. Upland crops.
P.7.		Average discharge of the primary canal (in liter/second)
P.8.		Average rice yields (tonnes/ha) P.8.a. Wet season. P.8.b. Dry season. P.8.c. Third season (if any)
P.9.		Average yields (tonnes/ha) of; P.9.a. Peanut. P.9.b. Soybean. P.9.c. Corn. P.9.d. Others; ________
P.10.		Total nhumber of farmers in the irrigation area.

CODE NUMBER	DATA CLASSIFICATION	SPECIFICATION
P.11.		Effectiveness of the WUA;
		P.11.a. Frequency of members' meeting.
		P.11.b. Frequency of mass field activity.
		P.11.c. Number of structures constructed/rehabilitated since the last survey.
		P.11.d. Length of canal constructed/rehabilitated since the last survey.
S.	SUPPLEMENTAL DATA	
S.1.		Daily records of streamflow.
S.2.		Daily records of rainfall.
S.3.		Monthly evapotranspiration.
S.4.		Daily discharge in the primary canal.
S.5.		Daily discharge to each tertiary block.
S.6.		Deep percolation rate.
MD	MAP AND DIAGRAM	
MD.1.	Topographic map of the irrigation area.	
MD.2.	Irrigation Network Schematic Diagram.	
MD.3.	Organizational structure of WUA.	

Appendix 2. Flowchart of data processing for the inventory of FMIS



Appendix 3. Data processed further and the output

CODE NUMBER	SPECIFICATION		OUTPUT
B.4. P.10.	Command area of tertiary block Total number of farmers	——›	Land ownership
B.4. P.1. P.2. P.3.	Command area of tertiary block Wet season cropping area Dry season cropping area Third season cropping area	——›	Cropping pattern Cropping intensity
P.1. S.2. S.3. S.6.	Wet season croppinng area Daily rainfall Monthly evapotranspiration Deep percolation rate	——›	Crop water requirement Irrigation water requirement
 S.1.	Irrigation water requirement Daily records of streamflow	——›	Water balance
 S.4.	Irrigation water requirement Daily discharge in the primary canal	——›	Overall irrigation efficiency
S.5.	Crop water requirement Daily discharge to each tertiary block	——›	Irrigation efficiency at tertiary level

Appendix 4. Tentative schedule of the implementation of inventory of FMIS

CODE NUMBER	SPECIFICATION	CROPPING PRIODE												REMARKS
		WET SEASON				DRY SEASON				THIRD SEASON				
		1	2	3	4	5	6	7	8	9	10	11	12	
B.1.	Name of irrigation area.												##	
B.2.	Number of tertiary blocks.												##	
B.3.	Names of tertiary blocks.												##	
B.4.	Command area of each tertiary blocks.												##	
B.5.	Technical specification of the headwork.												##	Benchmark da
B.6.	Technical specification of the canal.												##	
B.7.	Number of irrigation struc - tures.												##	
B.8.	Drainage system.												##	
B.9.	Irrigation infrastructure.												##	
B.10.	Water Users Association.												##	
P.1.	Wet season cropping area.		##											Seasonal
P.2.	Dry season cropping area.							##						Seasonal
P.3.	Third season cropping area.										##			Seasonal
P.4.	Wet season harvested area.					##								Seasonal
P.5.	Dry season harvested area.									##			##	Seasonal
P.6.	Third season harvested area.													Seasonal
P.7.	Average discharge of primary canal.	##	##	##	##	##	##	##	##	##	##	##	##	Monthly.
P.8.	Average rice yields.					##				##			##	Seasonal
P.9.	Average yields.												##	
P.10.	Total number of farmer in the irrigation area.		##											
P.11.	Effectiveness of the WUA.					##				##			##	Seasonal
S.1.	Daily records of streamflow.	######	######	######	######	######	######	######	######	######	######	######	######	
S.2.	Daily records of rainfall.	######	######	######	######	######	######	######	######	######	######	######	######	
S.3.	Monthly evapotranspiration.	##	##	##	##	##	##	##	##	##	##	##	##	
S.4.	Daily discharge in the prima- ry canal.	######	######	######	######	######	######	######	######	######	######	######	######	
S.5.	Daily discharge to each terti- ary block.	######	######	######	######	######	######	######	######	######	######	######	######	

Malaysian Case Study I: The Irrigation Scheme Information Scheme

M.N. Mohd Adnan[18]

INTRODUCTION

In 1989, a study on crop diversification and small irrigation schemes was undertaken under a technical cooperation program between the Governments of Japan and Malaysia. A major outcome of this study was a management information system (MIS) for the 924 irrigation schemes totalling 130,122 ha. The data are stored into two files (S-INFO and S-AREA) using dBASE IV software. S-INFO is comprised of 102 items of data primarily pertaining to the physical aspects of the irrigation scheme while S-AREA stores data on the planted areas. For the information retrieval system, 52 programs were prepared. This system has assisted in determining crop diversification potential for each scheme and is also used as a source of information for planning and management as well as a base to develop other information systems such as water resource planning. The same format could be used to develop an MIS for Farmer-Managed Irrigation Systems (FMIS). Although not a new concept, FMIS have yet to be positively developed in Malaysia. The current economic situation and policies such as industrialization, crop diversification, group farming, commercial orientation and privatization indicate that FMIS will be an important feature of future irrigation development. In developing FMIS, a suitable MIS is necessary both for agencies such as the Department of Irrigation and Drainage (DID) for monitoring and evaluation and to improve their performance.

Irrigation in Malaysia has developed almost exclusively for paddy. The DID, a technical department within the Ministry of Agriculture (MOA), is responsible for the planning, design, construction and management of irrigation systems.

Of over 600,000 hectares (ha) of paddy lands in the country, 52% or 342,650 ha have been provided with irrigation facilities while the remainder remain as rainfed areas.

The irrigated areas comprise eight large schemes totalling 212,528 ha and 924 small irrigation schemes scattered over the country and totalling 130,122 ha (Figure 1). All these schemes were developed and continue to be managed by the Government.

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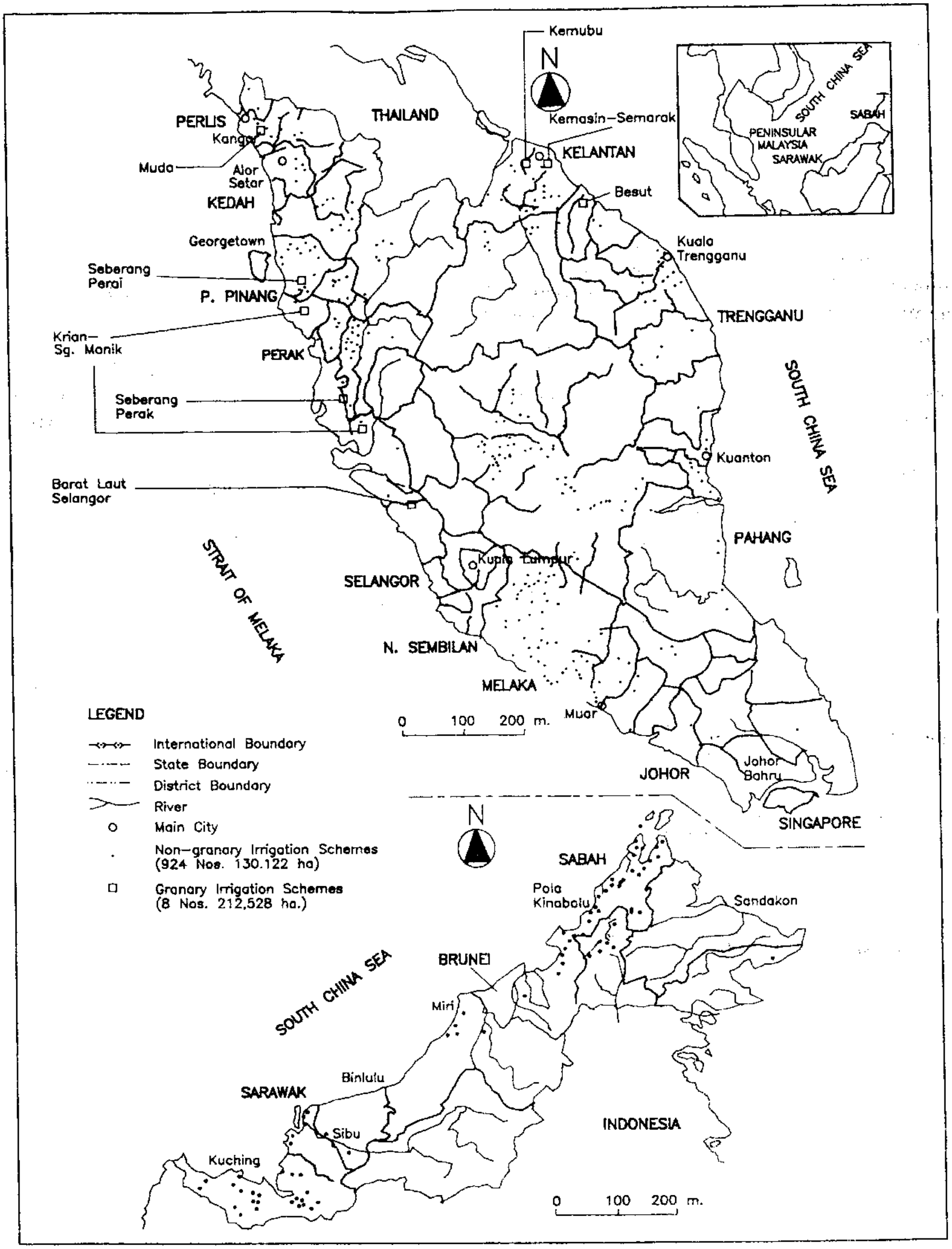
Figure 1. Irrigation schemes in Malaysia



Agriculture development (including irrigation) in Malaysia is guided by the National Agriculture Policy (NAP) which was enunciated in 1984 and is currently under the final stages of review. The policy stipulates that paddy production shall be focussed in the eight large irrigation schemes, also known as the Granaries, and that these areas be capable of producing at least 65% of the country's needs. The rest of the paddy areas, the rainfed and non-granary irrigated areas, shall be converted in phases into diversified crops. In-situ development is emphasized and farmers will be encouraged towards commercially oriented farming systems.

This means that while efforts will be to increase paddy productivity in the Granaries to meet the demands of the increasing population, special programs need to be developed for the non-granaries. Focussing initially on the non-granary irrigation schemes, a rationalization and crop diversification study (the Study) was carried out under a Technical Cooperation Program between the Governments of Japan (JICA) and Malaysia (GOM) in 1989. The 20-month Study included an inventory survey of the 924 schemes, a socio-economic survey and the identification of the potential (diversified) land use of each of the scheme (JICA, GOM 1990a, 1990b).

This paper focusses on the Management Information System (MIS) of the irrigation schemes which developed out of the inventory survey. The potential of developing Farmer Managed Irrigation Systems (FMIS) and expanding the MIS to support FMIS is also discussed.

THE INVENTORY SURVEY

The inventory survey for each scheme was carried out by distributing questionnaires to all DID offices throughout the country. The questionnaire was divided into two parts. Part I refers to the physical aspects of the scheme while Part II focusses on annual area planted. Information on irrigation systems were supplied by the DID and information pertaining to agriculture, socio-economy and marketing were obtained from the Department of Agriculture (DOA), the office of the District Officer, Farmer's Organization Authority (FOA) and from the Federal Agriculture Marketing Authority (FAMA). The list of information requested for in the inventory survey is shown in Appendix A.

The exercise was carried out over a 2-month period at the end of which nearly 90% of the information required was to be collected. The remaining information, not critical to the outcome of the study but nevertheless important, is expected to be furnished during the process of updating the database.

THE INFORMATION SYSTEM

All the information collected was checked, verified and stored using dBASE IV software. The computer used was a 386k IBM compatible computer with 40MB hard disk memory.

Two database files were created namely the "S-INFO.DBF" containing the information collected in Part I of the questionnaire and the "S-AREA.DBF" containing information of Part II (JICA, GOM 1990c).

A complete list of the data stored in the S-INFO.DBF file and S-AREA.DBF file is shown in Appendices B and C respectively.

Using these data, an MIS was developed using 52 programs (Appendix D). Sample output of these programs is shown in Appendix E.

USES OF THE MIS

The MIS was developed under this Study primarily to assist the DID in understanding in detail the existing condition of each irrigation scheme in technical and performance aspects. Using this MIS and results of a separate socio-economic survey involving 6,037 farm leaders and farmers to gauge the farmer's intention towards crop diversification in their schemes, a step-wise procedure for categorization of each scheme into eight potential landuses was developed under the Study. The categories of landuse identified are shown in Table 1 below.

Table 1. Diversification categories for non-granary irrigation schemes

CATEGORY	LANDUSE
1	Conversion to high value crops (e.g. vegetables, tobacco)
2	Conversion to tree crops (e.g. oil palm, fruits)
3	Paddy-upland crop rotation
4	Grazing/livestock rearing
5	Aquaculture
6	Maintained for paddy (secondary granary areas)
7	Maintains present situation for social reasons until pre-determined period for review
8	Converted to housing, industry

The step-wise procedure looked into seven key factors, namely: water resources availability, farmers' intention towards paddy cultivation and diversification, land suitability, soil suitability, crop profitability, crop marketability and investment performance. This led to the determination of the best option of landuse for each of the 924 schemes and their alternatives based on the above categories. Table 2 summarizes the number of schemes and total area identified for each of the category.

Table 2. Number of schemes and total area for each category of landuse

CATEGORY	NOS. OF SCHEMES	TOTAL AREA (Ha)
1	144	9,930
2	334	32,384
3	46	4,619
4	-	-
5	-	-
6	74	28,441
7	172	47,653
8	154	7,095

Under the Sixth Malaysia Development Plan, MR$5 million (US$1.9 million) has been allocated for the implementation of the crop diversification program.

Apart from the use of the MIS in the categorization procedure, it is currently serving managers and planners of agriculture and irrigation projects not just within the DID but in other agencies as well.

The MIS is currently being revised to suit the need of the national paddy production statistic committee chaired by the DOA with the Statistics Department, DID, National Paddy Board, (LPN), Malaysian Agriculture Research and Development Institute (MARDI), FOA, FAMA and representatives of the eight granaries as members. During each planting season, the committee conducts crop cutting surveys (CCS) in randomly selected plots of the paddy areas to estimate yields, collates and verifies reports of planted areas, fertilizer utilization as well as the paddy varieties planted. The DID reports primarily on the planted areas of all the non-granary irrigation schemes. The committee publishes a report for each of the planting season. In order to monitor diversification trends in the irrigation schemes, a pilot study on the data collection of non-paddy crops planted in these schemes is being planned and expected to be launched early next year. The MIS will then be expanded to include these details.

Another major use of this MIS is in monitoring investment and operation and maintenance (O&M) costs. The updating of these data is expected to start at the end of this year (1992). It is envisaged that the subsequent analysis of results gathered should indicate the cost of O&M in relation to the size of schemes and the type of system (gravity, pumping, controlled drainage etc.) as well as assisting in identification of sources of problems and formulation of strategies to overcome them.

For regional and national water resource planning and development, the MIS is used as a base for developing a new information system which will aid in the monitoring of present and forecasting future water supply and demand (domestic, industry and irrigation).

Perhaps one of the major potentials of this MIS is the possibility of using the same format to develop a comprehensive information system for farm managers in each of the irrigation schemes.

TOWARDS FARMER MANAGED IRRIGATION SYSTEMS (FMIS)

Although FMIS is not a new concept in Malaysia, it has yet to be recognized as a specific aspect of irrigation development program. The DID over the years has assisted various government and farmer organizations in the design and construction of small irrigation systems. However, these were undertaken as providing a special service and depends on the workload of the DID office at the time the request is made. It does not form part of the Department's annual work program. The Department's contribution is in terms of technical advice, expertise in design, or in the preparation of specifications and estimation of costs and in some cases, construction supervision. The Department does not allocate any funds for construction nor involved in O&M. This is left entirely to the clients and the DID only responds if further advice or input is sought.

Current trends and government policies however indicate that there is a need to develop FMIS in the country.

The present opportunity cost of labor favoring the manufacturing sector instead of agriculture has resulted in dwindling farm labour and increased occurrences of idle paddy lands in various parts of the country. The granaries have adjusted to this situation through mechanization of labour intensive activities such as land preparation and harvesting as well as adoption of direct seeding in place of transplanting. The non-granaries however, due primarily to economies of scale and their dispersed locations, could not fully adjust to the situation. To overcome this problem, the government is encouraging farmers or organize group farming under a single management. Farming objectives should be commercially oriented (as opposed to subsistence).

The expected impact this has on agriculture is that larger areas will be managed by a single entity (farm management) as opposed to the traditional system of many farmers operating small individual farms. The other impact is that although rainfall is generally adequate and that severe drought conditions are rare, irrigation using sprinklers and micro-systems for non-paddy crops such as fruits is on the increase. This is because commercial farms need to ensure continuity of supply and increase and maintain production to meet contractual commitments as well as to maintain quality farm products for competitive prices. Under such a system, the farm managers may prefer to have more control of the irrigation facilities rather than depend entirely on the DID.

Apart from the above, developing FMIS will be necessary as one of the strategies to meet the government's policies to reduce the size of the civil service, reduce farmer's dependence of government support and develop and increase the private sector's role in the national economy.

The implementation of the crop diversification program provides an opportunity to introduce FMIS. Under this program, the initial approach is to implement a pilot or demonstration project of about 20 ha in a selected scheme in each of the 14 states in the country. The farmers involved will be organized to form a single management group which will be responsible for the everyday running of the farm and will include choice of crops, cultivation activities and marketing. The group will also be responsible for irrigation scheduling and on-farm water management. This is where the need for MIS comes in. Being small, the probability is that the area will be located in one part of the scheme commanded by one or two irrigation lines. Since this is now commanding a larger area under one management, it seems feasible that the adjacent irrigation facilities or part of the system is managed and maintained by the project management group. Depending on the system layout and characteristics, the DID's role would be to manage the main system only.

Being a commercial entity, the O & M costs may be borne by the farmers for that section of the system. Alternatively, the DID may assist management in initial years until the farm achieves profitable returns. Even if the government continues to provide financial assistance indefinitely, there may be some advantages in terms of reduced staff size, emolument and pension funds.

While at the onset these advantages may be marginal since the size and number of FMIS is small, if successful, over time the entire scheme could be composed of several FMISs. In that situation, the DID's role would be supervisory and mainly to coordinate overall irrigation systems management.

However, an in-depth study need to be carried out prior to large-scale implementation of FMIS. The existing FMIS which appear to be successful could provide bases for developing appropriate models. Many of the existing FMISs are for orchards developed under a special program of the MOA to promote the commercial production of selected high value crops and those with export potentials such as carambola. Under this program, 21 pilot projects totalling 370 ha are in various phases of implementation. All these projects will be with irrigation. The Government will provide financial assistance in the form of grants or soft loans to develop water resources and install on-farm irrigation facilities. Technical advice for water resources development, irrigation systems design and installation are provided by the DID, DOA and MARDI. Construction works, supply and installation of system components are by private contractors. Basic training on system O&M is provided by the Departments involved during the commissioning period.

In paddy areas, the number of FMIS are few. Usually, the systems are very basic, comprising of either a single mobile pump or a structure to back-up flow in the drain for irrigation in adjacent areas. These are mostly installed in response to requests by farmers in rainfed areas where water resource are limited and not technically nor economically viable for total irrigation development.

One interesting FMIS developed is the Kampung Kekabu Scheme in the State of Kelantan (Wong et al. 1990). Here, the farmers' group, organized by the National Tobacco Board (NTB), plants tobacco in the dry season and paddy in the wet season. The NTB approached the DID to design and construct an irrigation system using groundwater as the water resource. Although the initial investment cost was borne by the NTB, farmers operate and maintain the systems themselves and the running cost of the electric pumps are paid (based on area operated by the individual farmer) by the farmers through deductions from proceeds of the sale of tobacco. A similar system is also in operation in the Bendang Pauh Scheme, Kelantan. Here, farmers are organized by the Area Farmers' Organization and paddy-tobacco-vegetable rotation is practiced.

MIS FOR FMIS

For the successful implementation of FMIS and as in other projects, monitoring and evaluation (M&E) of each system is an important process. Especially at the initial stages, government input will be necessary. Using the same format as the one developed by the Study, some of the parameters that will need to be included will be the infrastructure cost, the physical characteristics of the system, water demand and supply including water quality and O&M costs.

Apart from the technical parameters, additional data pertaining to crop cultivation practices and marketing will need to be included such as crop choice, fertilizer input, farm labour, production costs, yield, total produce, quality, farmgate price and market prices, types of services provided, their frequency and problems faced by the system managers. Such an MIS should in the long term assist in determining the degree of success or failure of the FMIS, identify problem areas and provide a more quantitative approach towards refining policies and strategies to promote FMIS programs.

At the on-farm level, the MIS developed should not only be designed to assist general management of the farm organization but should also be useful as a reporting format for the FMIS monitoring and evaluation system. Differences between the two would perhaps be in the degree of details to be monitored. At the on-farm level, the MIS should perhaps be designed to assist managers in determining areas where cost can be reduced without affecting the productivity. The system should also assist managers in improving their management approach and practices. For example, keeping records of rainfall and irrigation frequency, amount and duration and comparing this with the yields and fertilizer input should in the long term indicate the most appropriate management approach in their particular farms. The MIS could also act as a checklist for periodic maintenance of the system component in order to reduce/avoid major repair costs.

The list of parameters to be monitored can be endless and considering that farm managers have to tend to the various aspects of production, very little time can be spared for extensive data collection. The system should therefore be such that it does not become a burden but instead be simple and useful.

CONCLUSION

The MIS developed for the non-granary irrigation schemes, although relatively new, has shown usefulness in monitoring the performance of each of the irrigation schemes in terms of planted area, yield, production and O&M costs. Apart from that, the MIS is also used as a source of information by systems managers and planners. Using the MIS established as a base, various other information system can be developed. An example is the development of an MIS for water resource planning and development.

The MIS can also be reformatted and expanded for FMIS. Although not a new concept, the numbers of FMIS in Malaysia are few. There are at present no specific programs to develop FMIS. However, the current economic situation in the country, government policies in encouraging group farming and the new commercial orientation and privatization efforts indicate that FMIS will have to be the characteristic of future irrigation development. Current efforts to diversify non-granary irrigation schemes into non-paddy crops provide an opportunity to further develop FMIS.

In-depth studies of existing FMIS in the country and exchange of information with other countries should be carried out in order to formulate an appropriate FMIS program. For implementation, suitable MIS will be useful for monitoring and evaluation by agencies such as the DID and this must be complemented by an MIS for farm management.

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Appendix A. List of information requested during the inventory survey

Main Item	Item	Sub Item
Overall	General	Scheme code number, name of scheme, location, type of scheme, year of completion, area of scheme, major towns nearby accessibility.
	Socio-economy	Name, population, household number and farm household number of Mukin in which scheme is located; total number and land holding size of beneficiary farm households; land holding and tenure situations.
	Topography and land series	Topography, elevation, ground slope, soil survey previously done, soil conditions, typical land use around scheme.
	Agricultural development project	Existence of on-going rural and agricultural development projects covering scheme; name, responsible agency and sponsoring of project.
Facility	Water source	Name of water source river, river gauging station, diversion discharge, catchment area at diversion point, representative rainfall and meteorological station, quality of irrigation water.
	Irrigation water demand requirement	Designed discharge value, actual diverted discharge, situation and affected area of water shortage in normal year, main reasons of water shortage.
	Irrigation facilities	Type of diversion structures, headworks, pumphouse, intake structure at diversion site, total length of irrigation canal, canal structures, specific problems.

	Drainage and flood control facilities	Total length of drainage channels, drainage structures, drainage conditions, main reasons of poor drainage, area affected by floods, estimated flood damage, measures for flood mitigation with estimated costs.
	Farm road	Length and width of farm roads, surface pavement, specific problems, trunk road connected.
	Operation and maintenance	Responsible office, supervisory staff, O&M field staff and annual O&M costs.
	Investment cost	Initial investment cost, major rehabilitation cost.
	Water charge	Basic rate, situation of collection, main reason of difficulty to collect water charge.
Cropping	Land use	Land use changes and actual cultivated area for the previous five years, situation of idle land.
	Farming system	Farm operating system, cropping pattern, farm plot condition, use, possession and rental fee of agricultural machinery.
	Crop production	Crop yield and total crop production for the previous five years.
	Crop budget	Farm gate prices and production costs of crops, specific problems against increasing crop production.
Supporting services	Post harvest facilities	Rice mill facilities, storage facilities, processing facilities other than tree crops.
	Agricultural services association	Farmers' association, farmers' cooperatives, extension services, available credit services, farm input supply, selling of crops, specific problems concerning supporting services.

Appendix B. List of data stored in S_INFO.DBF file (1/ 4)

	Item	Content of Data	Remarks
1	CODE	Code number of the scheme	
2	NAME	Name of the scheme	
3	STATE	Name of the state in the scheme area	
4	DISTRICT	District name in the scheme area	
5	MUKIM	Mukim name in the scheme area	
6	TYPE	Type of the scheme G : Gravity P : Pump CD : Controlled drainage I : Inundation O : Others	
7	C_YEAR	Year of completion	
8	KM_S_CAP	Distance from state capital	km
9	KM_D_CAP	Distance from district capital	km
10	NO_HOUSE	Number of households	
11	L_HOLD_AVE	Average land holding size	ha
12	L_HOLD_MAX	Maximum holding size	ha
13	L_HOLD_MIN	Minimum land holding size	ha
14	L_OPE_O	Area of owner operator	ha
15	L_OPE_TO	Area of tenant /owner operator	ha
16	L_OEP_T	Area of tenant operator	ha
17	L_GOV	Area of governmental land	ha
18	L_NON_GOV	Area of non-governmental land	ha
19	TOPO	Topographic condition a : Alluvial flat b : Valley bottom c : Terrace d : Hilly	
20	EL_AVE	Average elevation in the area	m
21	EL_HIGH	Highest elevation in the area	m
22	EL_LOW	Lowest elevation in the area	m
23	SLOPE	Land slope in the area	1 : X
24	SOIL	Name of soil series in the project area C : Clay HC : Heavy clay L : Loam S : Silt O : Others	

Appendix B. List of data stored in S_INFO.DBF file (2/ 4)

	Item	Content of Data	Remarks
25	OUTSIDE_LU	Land use outside the scheme area a : Village b : Paddy field c : Oil palm d : Rubber e : Cocoa/Coconut f : Upland crops g : Grass land h : Forest i : Others	
26	RIVER_NAME	River name at diversion site	
27	R_SYSTEM	Name of river system	
28	RIVER_STA	Name of river gauging station	
29	LOW_FLOW	Annual low flow	m^3/s
30	LOWEST_LF	Annual lowest low flow	m^3/s
31	LOW_MONTH	Month of lowest low flow occurs	
32	CATCH_AREA	Catchment area at diversion site	km^2
33	RAIN_STA	Name of rainfall station	
34	METEO_STA	Name of meteorological station	
35	W_QUALITY	Irrigation water quality a : Not polluted b : Polluted by swamp water c : Polluted by effluent from rubber processing d : Polluted by effluent from oil processing e : Polluted by tin mine effluent f : Polluted by industrial effluent g : Polluted by piggery waste h : Others	
36	DESIGN_Q	Design diversion requirement	m^3/s
37	Q_MEASURE	Availability of discharge measurement at intake Y : Available N : Not available	
38	W_SHORTAGE	Water shortage situation a : No water shortage b : Occasional water shortage happen c : Frequent water shortage happen	
39	OCCASIONAL	Area under occasional water shortage	ha
40	FREQUENT	Area under frequent water shortage	ha
41	SERIOUS	Area under serious water shortage	ha

Appendix B. List of data stored in S_INFO.DBF file (3/ 4)

	Item	Content of Data	Remarks
42	WS_REASON	Reasons of water shortage a : Shortage of river discharge b : Less flow capacity of canals by poor maintenance c : Malfunction of irrigation facilities d : Improper design of facilities e : Excessive use of water by farmer f : Others	
43	DIV_TYPE	Type of diversion structure a : Headworks b : Pumphouse c : Run-of-the river d : Others	
44	HW_YEAR	Year of completion of headworks	
45	NO_BAY	Number of gates at intake	
46	GATE_SIZE	Size of gate at intake weir	m
47	FLOOD_Q	Design flood discharge of headworks	m^3/s
48	OPE_CNDTN	Operation condition of headworks G : Good P : Poor B : Broken	
49	PUMP_YEAR	Year of completion of pump station	
50	NO_PUMP	Number of pump	
51	UNIT_CAPA	Unit capacity of pump	m3/s
52	PUMP_CAPA	Total capacity of pump	m3/s
53	PUMP_HEAD	Actual pumping head	m
54	D_POWER	Driven system of pump D : Diesel engine E : Electric motor	
55	P_OPE_CON	Operation condition of pump G : Good P : Poor B : Broken	
56	NO_IN_GATE	Number of intake gates	
57	IN_G_SIZE	Size of intake gate	m
58	G_MATERIAL	Material of gate S : Steel W : Wood	
59	I_OPE_CON	Operation condition of intake gate G : Good P : Poor	
60	M_CANAL_TL	Total length of main canal	km
61	M_CANAL_LL	Total lining length of main canal	km
62	M_CANAL_RL	Length to be rehabilitated of main canal	km
63	S_CANAL_TL	Total length of secondary canal	km
64	S_CANAL_LL	Total lining length of secondary canal	km
65	S_CANAL_RL	Length to be rehabilitated of second. canal	km

Appendix B. List of data stored in S_INFO.DBF file (4/ 4)

	Item	Content of Data	Remarks
66	T_CANAL_TL	Total length of tertiary canal	km
67	T_CANAL_LL	Total lining length of tertiary canal	km
	T_CANAL_RL	Length to be rehabilitated of tertiary canal	km
68	NO_C_ST	Number of canal structures	
69	NO_C_GATE	Number of canal structures with gate	
70	CS_OPE_CON	Operation condition of canal structure G : Good P : Poor B : Broken	
71	DRAIN_TL	Total length of drainage canal	km
72	DRAIN_RL	Length to be rehabilitated of drainage canal	km
73	BUND_TL	Total length of dike	km
74	NO_D_ST	Number of drainage structure	
75	DS_OPE_CON	Operation condition of drainage structures G : Good P : Poor B : Broken	
76	DRAIN_GOOD	Area with good drainage condition	ha
77	DRAIN_POOR	Area with poor drainage condition	ha
78	DRAIN_DIFF	Area under difficult to drain for crop	ha
79	FLOOD_CON	Situation of flood Y : Flood N : No flood	
80	F_AREA_1Y	Area affected by annual flood	ha
81	F_AREA_5Y	Area affected by every five years	ha
82	F_AREA_MAX	Area affected by recorded maximum flood	ha
83	MAX_F_YEAR	Year of recorded maximum flood	
84	M_ROAD_TL	Total length of main road	km
85	M_ROAD_RL	Length to be rehabilitated of main road	km
86	S_ROAD_TL	Total length of secondary road	km
87	S_ROAD_RL	Length of secondary road to be rehabilitated	km
88	T_ROAD_TL	Total length of tertiary road	km
89	T_ROAD_RL	Length of tertiary road to be rehabilitated	km
90	OM_COST83	Annual O & M cost (1983)	M$
91	OM_COST84	Annual O & M cost (1984)	M$
92	OM_COST85	Annual O & M cost (1985)	M$
93	OM_COST86	Annual O & M cost (1986)	M$
94	OM_COST87	Annual O & M cost (1987)	M$
95	OM_COST88	Annual O & M cost (1988)	M$
96	OM_COST89	Annual O & M cost (1989)	M$
97	OM_COST90	Annual O & M cost (1990)	M$
98	OM_COST91	Annual O & M cost (1991)	M$
99	OM_COST91	Annual O & M cost (1991)	M$
101	C_COST	Initial investment cost	M$
102	R_COST	Major rehabilitation cost	M$

Appendix C. List of data stored in S_AREA.DBF file (1/ 3)

	Item	Content of Data		Remarks
1	CODE	Code number of the scheme		
2	NAME	Name of the scheme		
3	STATE	Name of the state in the scheme area		
4	DISTRICT	District name in the scheme area		
5	TYPE	Type of the scheme G : Gravity P : Pump CD : Controlled drainage I : Inundation O : Others		
6	GROSS_AREA	Gross irrigable area		ha
7	I_AREA_MS	Irrigable area in main season		ha
8	I_AREA_OS	Irrigable area in off season		ha
9	PMS83	Paddy planted area.	1983 main season	ha
10	POS83	-do-	1983 off season	ha
11	PMS84	-do-	1984 main season	ha
12	POS84	-do-	1984 off season	ha
13	PMS85	-do-	1985 main season	ha
14	POS85	-do-	1985 off season	ha
15	PMS86	-do-	1986 main season	ha
16	POS86	-do-	1986 off season	ha
17	PMS87	-do-	1987 main season	ha
18	POS87	-do-	1987 off season	ha
19	PMS88	-do-	1988 main season	ha
20	POS88	-do-	1988 off season	ha
21	PMS89	-do-	1989 main season	ha
22	POS89	-do-	1989 off season	ha
23	PMS90	-do-	1990 main season	ha
24	POS90	-do-	1990 off season	ha
25	PMS91	-do-	1991 main season	ha
26	POS91	-do-	1991 off season	ha
27	PMS92	-do-	1992 main season	ha
28	POS92	-do-	1992 off season	ha
29	T_CROP83	Tree crop planted area.	1983	ha
30	T_CROP84	-do-	1984	ha
31	T_CROP85	-do-	1985	ha
32	T_CROP86	-do-	1986	ha
33	T_CROP87	-do-	1987	ha
34	T_CROP88	-do-	1988	ha
35	T_CROP89	-do-	1989	ha
36	T_CROP90	-do-	1990	ha
37	T_CROP91	-do-	1991	ha
38	T_CROP92	-do-	1992	ha

Appendix C. List of data stored in S_AREA.DBF file (2/ 3)

	Item	Content of Data	Remarks
39	A_CROP83	Annual crop planted area, 1983	ha
40	A_CROP84	-do- 1984	ha
41	A_CROP85	-do- 1985	ha
42	A_CROP86	-do- 1986	ha
43	A_CROP87	-do- 1987	ha
44	A_CROP88	-do- 1988	ha
45	A_CROP89	-do- 1989	ha
46	A_CROP90	-do- 1990	ha
47	A_CROP91	-do- 1991	ha
48	A_CROP92	-do- 1992	ha
49	FRUIT83	Fruit crop planted area, 1983	ha
50	FRUIT84	-do- 1984	ha
51	FRUIT85	-do- 1985	ha
52	FRUIT86	-do- 1986	ha
53	FRUIT87	-do- 1987	ha
54	FRUIT88	-do- 1988	ha
55	FRUIT89	-do- 1989	ha
56	FRUIT90	-do 1990	ha
57	FRUIT91	-do- 1991	ha
58	FRUIT92	-do- 1992	ha
59	OTHER83	Other land use, 1983	ha
60	OTHER84	-do- 1984	ha
61	OTHER85	-do- 1985	ha
62	OTHER86	-do- 1986	ha
63	OTHER87	-do- 1987	ha
64	OTHER88	-do- 1988	ha
65	OTHER89	-do- 1989	ha
66	OTHER90	-do- 1990	ha
67	OTHER91	-do- 1991	ha
68	OTHER92	-do- 1992	ha
69	IDLE_YEAR	Year of first occurrence of idle land	
70	CAUSE_IDLE	Reason of occurrence of idle land	
71	F_SYSTEM	Type of farming system a : Individual farmers b : Farmers unit c : Group farming d : Farmers association e : Others	
72	PLOT_SIZE	Standard plot size	ha
73	F_MACHIN	Type of farm machineries presently used a : Land preparation b : Transplanting c : Weeding d : Spraying e : Harvesting f : No use in anv form	

Appendix C. List of data stored in S_AREA.DBF file (3/ 3)

	Item	Content of Data		Remarks
74	PMSY83	Unit yield,	main season paddy in 1983	t/ha
75	POSY83	-do-	off season paddy in 1983	t/ha
76	PMSY84	-do-	main season paddy in 1984	t/ha
77	POSY84	-do-	off season paddy in 1984	t/ha
78	PMSY85	-do-	main season paddy in 1985	t/ha
79	POSY85	-do-	off season paddy in 1985	t/ha
80	PMSY86	-do-	main season paddy in 1986	t/ha
81	POSY86	-do-	off season paddy in 1986	t/ha
82	PMSY87	-do-	main season paddy in 1987	t/ha
83	POSY87	-do-	off season paddy in 1987	t/ha
84	PMSY88	-do-	main season paddy in 1988	t/ha
85	POSY88	-do-	off season paddy in 1988	t/ha
86	PMSY89	-do	main season paddy in 1989	t/ha
87	POSY89	-do-	off season paddy in 1989	t/ha
88	PMSY90	-do-	main season paddy in 1990	t/ha
89	POSY90	-do-	off season paddy in 1990	t/ha
90	PMSY91	-do-	main season paddy in 1991	t/ha
91	POSY91	-do-	off season paddy in 1991	t/ha
92	PMSY92	-do-	main season paddy in 1992	t/ha
93	POSY92	-do-	off season paddy in 1992	t/ha
94	F_ASSO	Existence of farmers' association Y : Yes N : No		
95	NO_F_ASSO	Number of farmers' association		
96	F_COOP	Existence of farmers' cooperatives Y : Yes N : No		
97	NO_F_COOP	Number of farmers' cooperatives		

Appendix D. List of programmes (1/ 2)

Name of Program.	Information and Data Retrieved	
Summary state by state		
Nation01	Irrigable Area by State	
Nation02	Paddy planted area,	1983 - 1987
Nation03	-do-	1988 - 1992
Natión04	Tree crop area,	1983 - 1987
Nation05	-do- 1988 - 1992	
Naition06	Annual crop area,	1983 - 1987
Nation07	-do-	1988 - 1992
Nation08	Fruits planted area.	1983 - 1987
Nation09	-do-	1988 - 1987
Nation10	Other crop area,	1983 - 1987
Naiton11	-do- 1988 - 1992	
Naiton12	Size of scheme	
Nation13	Type of scheme	
Nation14	Unit yield of paddy,	1983 - 1987
Nation15	-do-	1988 - 1992
Naiton16	Paddy production by state,	1983 - 1987
Naiton17	-do-	1988 - 1992

Part-1 Data (Physical conditions of the scheme)

Inf1	Location of Irrigation Schemes
Inf2	Land Operation Situation by Scheme
Inf3	Physical Condition of Schemes
Inf4	Hydrological Information of Schemes
Inf5	Hydrological Condition of Schemes
Inf6	Water Shortage of Schemes
Inf7	Type of Schemes and Facilities by Schemes
Inf8	Situation of Existing Headworks
Inf9	Situation of Existing Pumping Stations
Inf10	Situation of Existing Intake Facilities
Inf11	Situation of Existing Irrigation Canals
Inf12	Farmers Association and Cooperatives by Scheme
Inf13	Situation of Existing Drainage Canals
Inf14	Situation of Flood
Inf15	Situation of Existing Farm Roads
Inf16	Construction, Major Rehabilitation and Annual O&M Cost. 1983 - 1987
Inf17	-do- 1988 - 1992

Appendix D. List of programmes (2/ 2)

Name of Program.	Information and Data Retrieved	
Part-2 Data		
Area1	Irrigable Area by Scheme	
Area2	Paddy planted area.	1983 - 1987
Area3	-do-	1988 - 1992
Area4	Tree crop area.	1983 - 1987
Area5	-do- 1988 - 1992	
Area6	Annual crop area.	1983 - 1987
Area7	-do-	1988 - 1992
Area8	Fruit planted area.	1983 - 1987
Area9	-do-	1988 - 1992
Area10	Other crop area.	1983 - 1987
Area11	-do- 1988 - 1992	
Area12	Condition of mechanized farming	
Area13	Unit yield of paddy.	1983 - 1987
Area14	-do-	1988 - 1992
Area15	Condition of farmers' association	

Appendix E. Sample output of the MIS for non-granary irrigation schemes

Table 1 Irrigable Area by State

(ha)

State	Gross Area	Irrigable Area Main Paddy	Irrigable Area Off Paddy
Perlis	4,911	4,215	475
Kedah	20,995	17,133	13,510
P.Pinang	17,639	3,541	3,525
Perak	15,249	12,722	12,236
Selangor	2,238	939	486
N.Sembilan	12,031	10,934	5,285
Melaka	12,100	7,149	2,279
Johor	4,791	4,010	3,924
Pahang	24,287	17,430	4,503
Terengganu	20,382	9,083	5,543
Kelantan	15,418	10,667	3,185
Sabah	27,279	17,163	7,774
Sarawak	20,688	15,136	2,387
Total	198,008	130,122	65,112

Table 2 Trend of Irrigated Paddy Area by State (1983 - 1987)

State	Main Season Paddy 1983 (ha)	1984 (ha)	1985 (ha)	1986 (ha)	1987 (ha)	1987/1983	Off Season Paddy 1983 (ha)	1984 (ha)	1985 (ha)	1986 (ha)	1987 (ha)	1987/1983
Perlis	4,086	4,086	4,061	4,084	4,084	1.00	0	0	0	0	0	**.**
Kedah	10,022	11,683	11,544	11,934	12,455	1.24	7,778	8,447	7,900	8,380	9,172	1.18
P.Pinang	3,598	3,617	3,267	3,358	3,518	0.98	3,370	3,754	3,257	3,308	3,504	1.04
Perak	8,061	6,159	7,438	7,181	7,113	0.88	6,517	5,584	4,042	5,020	6,833	1.05
Selangor	300	281	252	236	170	0.57	151	63	248	52	153	1.01
N.Sembilan	2,994	2,989	2,513	2,417	1,996	0.67	610	719	968	703	906	1.49
Melaka	2,936	2,909	2,145	1,781	2,003	0.68	553	473	596	545	552	1.00
Johor	1,579	1,780	1,435	1,572	1,109	0.70	1,381	1,483	868	1,385	1,177	0.85
Pahang	1,378	1,648	1,557	1,570	1,631	1.18	352	276	483	497	735	2.09
Terengganu	6,455	6,338	6,362	6,479	6,417	0.99	2,023	2,293	1,595	1,831	2,947	1.46
Kelantan	6,158	6,703	6,133	6,983	7,452	1.21	1,101	1,574	1,617	1,769	1,791	1.63
Sabah	11,400	12,004	11,926	12,942	12,486	1.10	1,377	2,198	2,092	2,967	2,749	2.00
Sarawak	2,770	3,999	5,880	5,731	5,477	1.98	380	298	322	109	155	0.41
Total	61,737	64,196	64,533	66,270	65,911		25,593	27,162	23,988	26,566	30,673	

Malaysian Case Study II: Kampung Kekabu Farmer-Managed Irrigation Systems

A.M. Ansor[19]

INTRODUCTION

Although farmer-managed irrigation systems (FMIS) had been practiced and exist traditionally and continue to be developed throughout the country, the Department of Irrigation and Drainage (DID) has not maintained any form of monitoring or evaluation system to keep track of these schemes. The future of FMIS will be an important part of agricultural development in the country. Therefore, it necessitates the establishment of a management information system (MIS) in the department is necessary in order to improve and develop the FMIS.

FMIS is no a new concept in Malaysia. Over the years the DID has been involved in the design and construction of small irrigation schemes most of which were upon request of farmers through various Government agencies. Eventually, management of these irrigation schemes were handed over to the farmers. One of these is the Kampung Kekabu Irrigation Scheme.

BACKGROUND

In 1986, a request was made to the government by the National Tobacco Board (NTB) for an irrigation project in Kampung Kekabu to overcome the problem of water shortage during dry periods. Water resources were not plentiful enough to support two crops of rice a year. The average rainfall allows farmer to plant paddy single-cropped. The fields were left idle during the dry season. They wanted to plant tobacco if water was available in rotation with paddy. Later in 1989, an investigation carried out by the DID had indicated the availability of ground water resources in the area. The NTB, as a semi-autonomous government agency, was allocated MR$130,000 (US$52,000) for the implementation of the scheme. The planning, design and construction works were carried out by DID and was completed in 1990. Since 1991, NTB had organized group farming through a system known as the Grower Curer System. Part of the management of the scheme was carried out by farmers, including operation and maintenance works.

Farmer participation in the day-to-day operation and maintenance (O&M) of the irrigation scheme has set a model of farmer-managed irrigation which can be practiced in other areas.

This case study presents a model of an FMIS implemented in the Kampung Kekabu Irrigation Scheme.

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Physical Layout

Kampung Kekabu is situated about 3.5 km. to the southwest of Pasir Mas township. It comprises an area of approximately 65 hectares (160 acres) of paddy lands. Physically, the area is flood free except for occasional overflows from the Kelantan river. (See Figures 1, 2 and 2A.)

Figure 1. Location map of the State of Kelantan

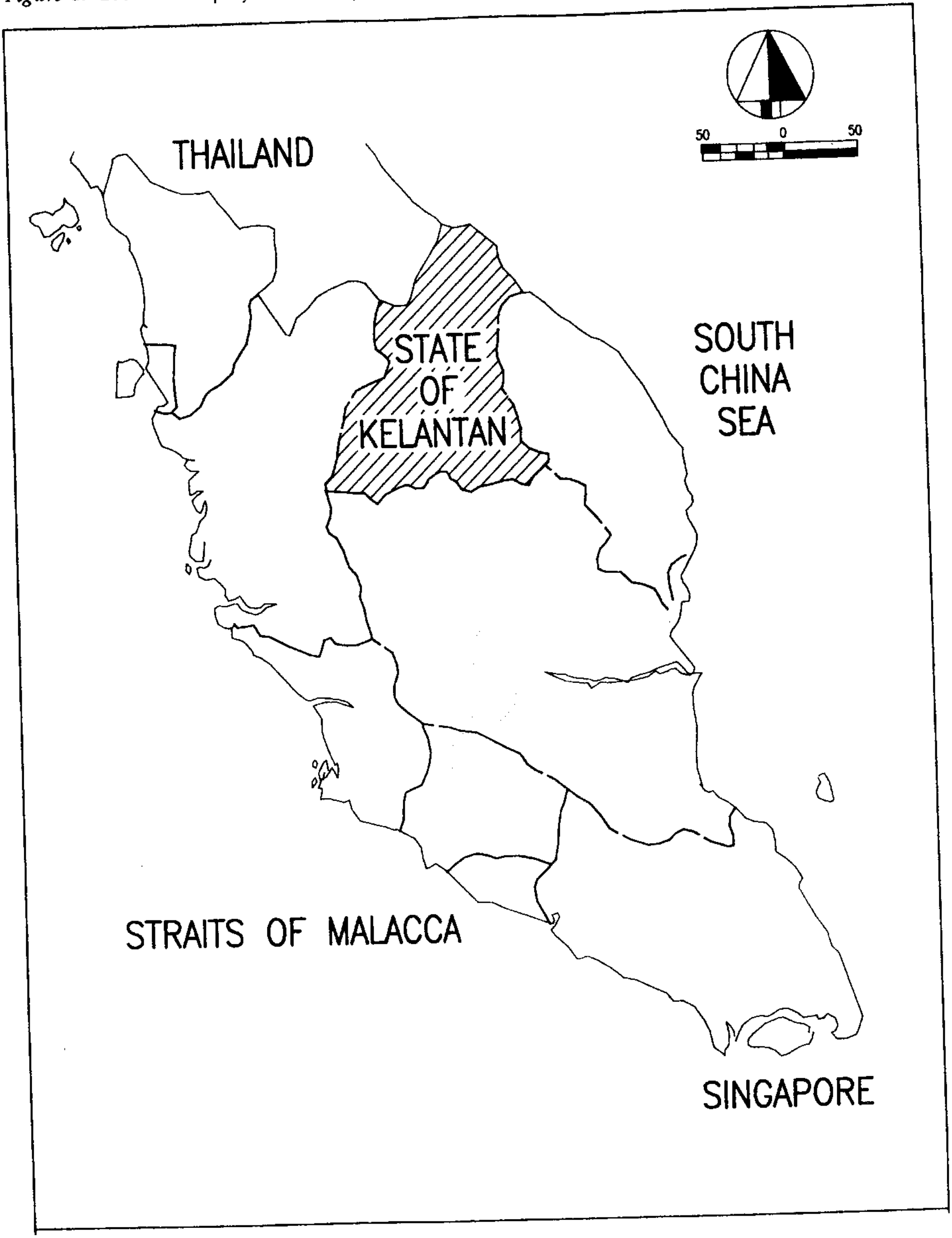


Figure 2. Location map of Kampung Kekabu

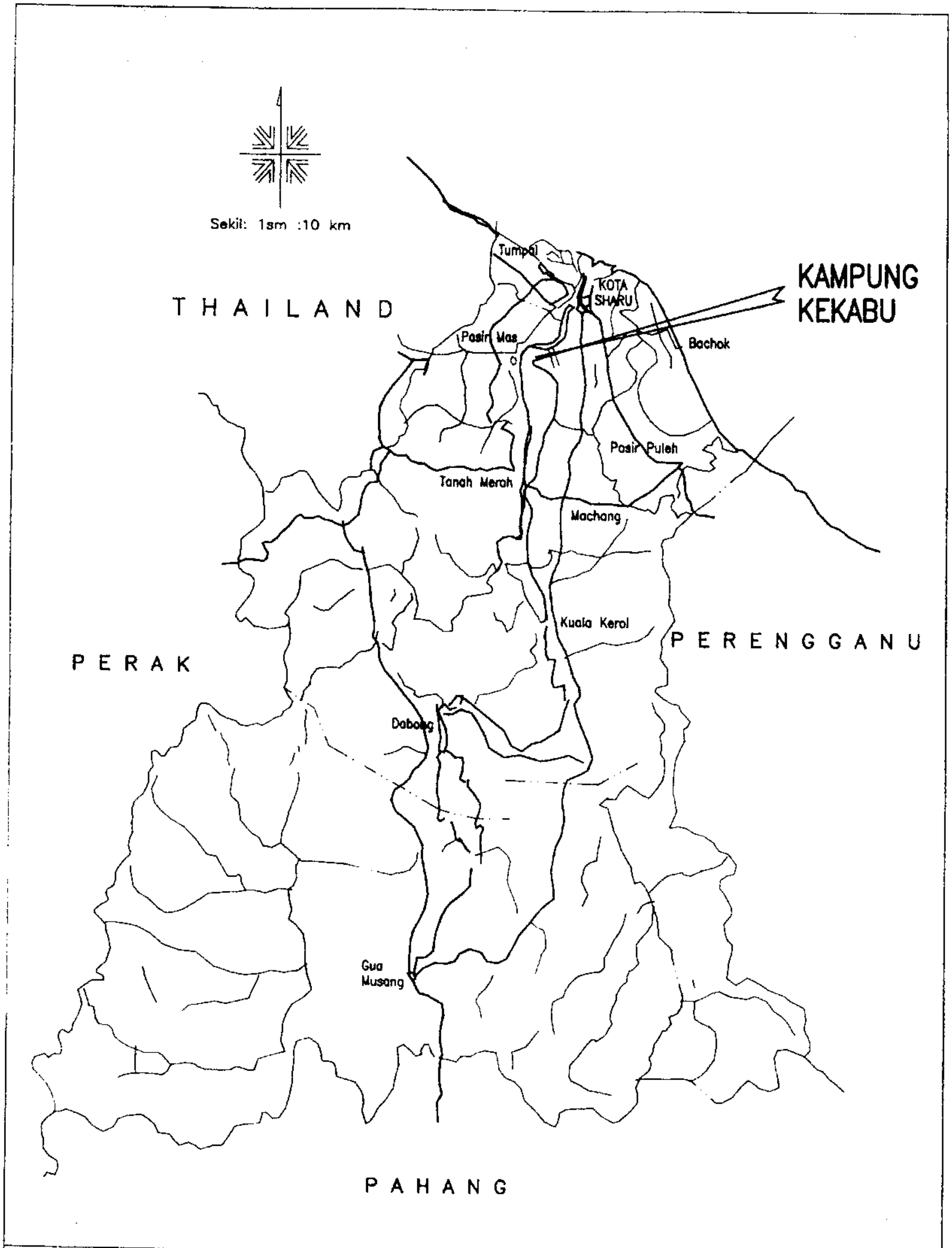
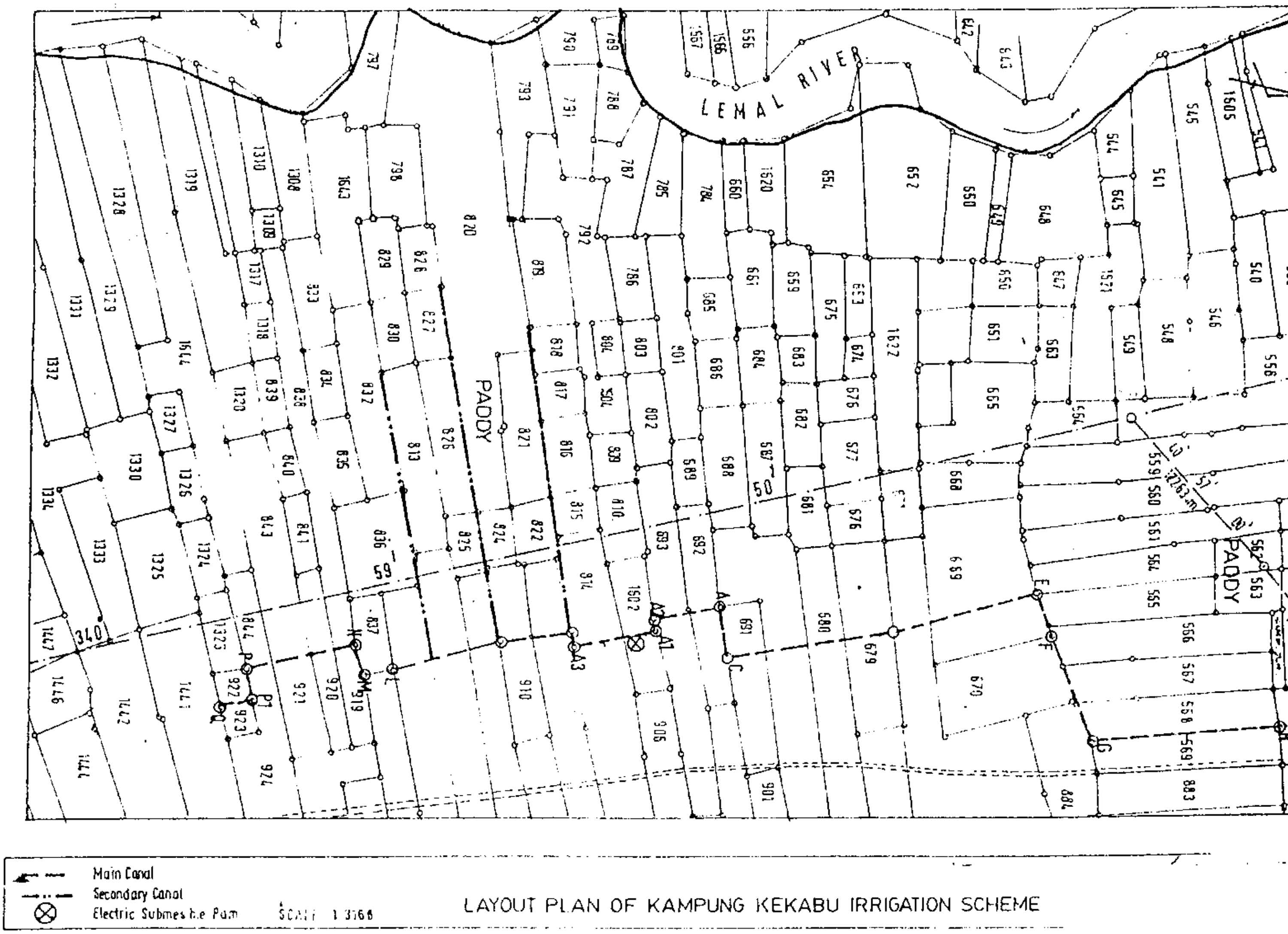


Figure 2A. Layout plan of Kampung Kekabu Irrigation Scheme



Most of the people living here are engaged in small holding farming activities either on a full or part time basis, for their source of income. The crops planted were mostly paddy. The yields were poor as there was a lack of irrigation facilities to meet agricultural requirements.

Soils

Soil surveys had identified the soil around the Kampung Kekabu scheme as the Tok Yong series on the upper terrace. Chempaka soil series have textures which range from silty clay loam to sandy clay loam. The soil reaction was found to be within the range of pH 4.5 to 5.5. Soils are well drained and suitable for tobacco during the dry season.

Agro-Hydrology

Average annual rainfall in the State of Kelantan is approximately 280mm/year of which 50% generally falls during the north-east monsoon (November to January) (Figure 3). The months of February to May are relatively dry, with the rainfall intensity increasing steadily towards the monsoon season. Annual evaporation is 1700 mm/year, while the annual deep percolation in the area is 22% of the annual rainfall.

IRRIGATION SYSTEM

The Pumping System

In the Kekabu Underground Water Pump Installation scheme, the borelog and arrangement of the pump is as illustrated in Figure 4. Seventy-two hours pumping tests using the airlift method were performed. Result of the test and aquifer analysis are:

Aquifer depth = 21 m
Pumping Rate = 3820 cu. m/d
Transmissivity = 1420 sq. m/d
Permeability = 77.6 m/d
Storage coeff. = 4.7 x 10-6.

Based on the data obtained from the yield tests, the production discharge suggested is 70 litre per second (lit/sec) while maximum pumping water level and suggested pump setting level is 13.32 m and 17 m below static water level respectively. To extract water from the well, an electrical motor driven submersible pump was proposed to be used. The capacity of the pump is 62 lit./sec.

Figure 3. Average rainfall in the State of Kelantan

AVERAGE MONTHLY RAINFALL AT TOK UBAN FOR 5 YEARS PERIOD (1987 – 1991)	
MONTH	AVERAGE (mm)
JAN	136.4
FEB	31.1
MAR	45.9
APR	110.0
MAY	162.6
JUN	147.3
JUL	187.1
AUG	228.9
SEP	301.9
OCT	241.7
NOV	523.5
DEC	561.0

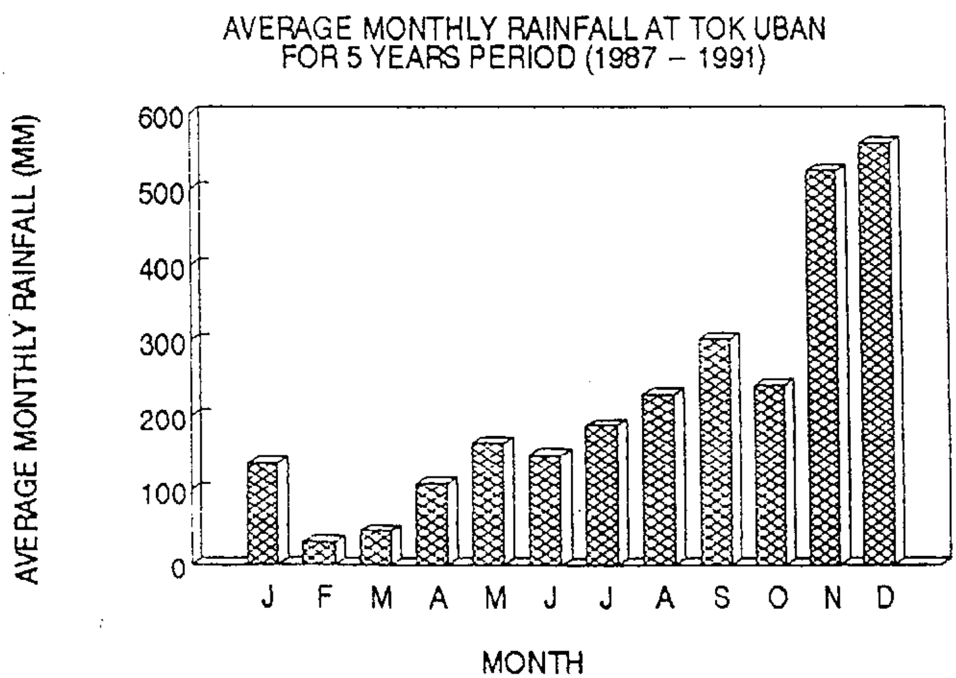
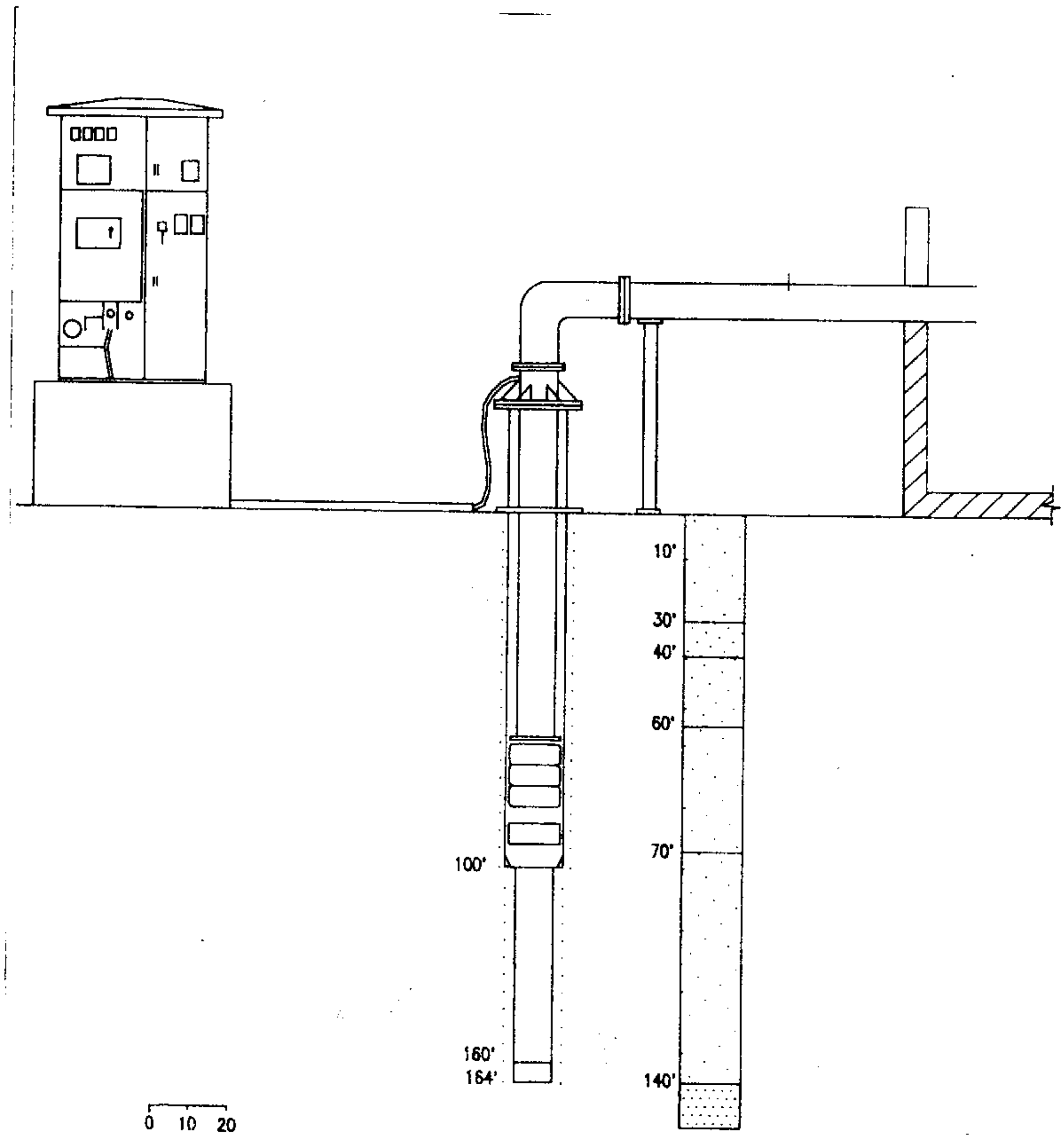


Figure 4. Kekabu underground water pump installation



The Canal System

The canal system is an open channel concrete conduit flume elevated on concrete stumps. This is to meet the required hydraulic gradient as well as to minimize the use of land and to avoid land acquisition. The size of the channel range from 30 cm to 45 cm in depth. The field offtakes (water outlet valves) are provided at certain intervals for water distribution to the fields. Other associated structures are canal crossings, road culverts, corner boxes and end controls. A localized drainage problem was encountered. A drain of 350m length was constructed by the Curer responsible for that location. The cost of the construction was incurred by the growers benefited at later stage through deduction sale of the product to the Curer. At the on-farm level, farmers are expected to play their role by collectively constructing head ditches along the canal and then perpendicularly making furrows to irrigate the crop. The field offtakes can be regulated by farmers to supply water to their head ditches, as required.

In Malaysia, the tobacco crop is grown on padi land as a "cash' crop during the off season period. In the padi land, tobacco fits into the rotation very well because padi requires a definite wet season in order that the crop may be inundated for a major portion of growing period. Tobacco is better suited to the drier part of the year and, because of this the time of planting for tobacco in padi land is limited to the padi off season, which in most cases, covers a period of about five to seven months.

Organizational Structure

As the main organizer of the project, the NTB is interested in growing tobacco. However, due to the farmers' traditional preference, paddy planting has to be continued during wet season. Farmers believe that by having the rotation, crops can avoid disease, thereby increasing the yield. This is true because by growing these crops in rotation, not only the balance of plant nutrients in the soils are maintained but, at the same time, the life cycles of many soil borne pests and pathogens are disrupted, bringing about a reduction in their population. Because of this two kinds of farmer organization are formed in the scheme during these two different planting seasons.

Farmer Management during Dry Season

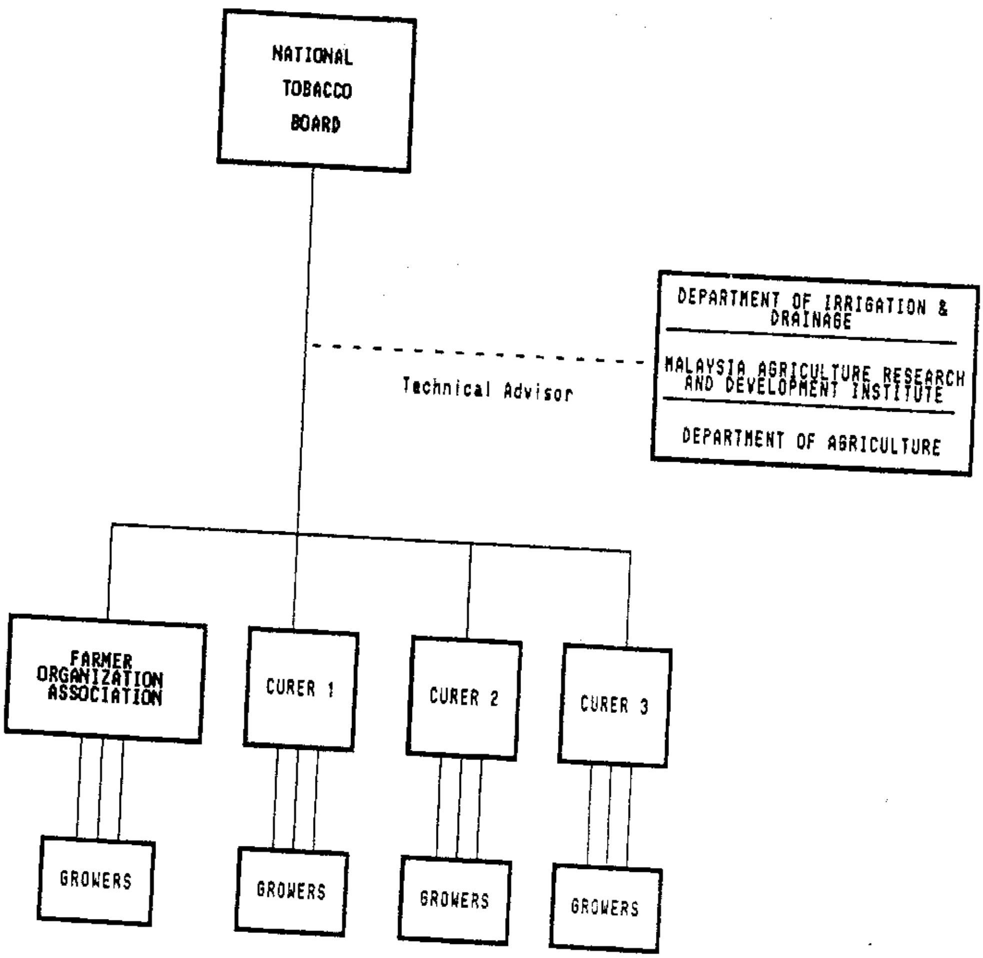
Tobacco is grown during dry period in the months of February to July. The general farm organization at this period is as shown in Figure 5. A total of 43 growers were involved during the last planting season in the dray season farm organization. The NTB is very firm with the adherence to the planting dates. The planting schedule is planned and fixed by the NTB at Headquarters level annually and made known to farmers and interested parties throughout the country in advance. This planting schedule is printed in the form of pamphlets and distributed to the district offices.

Growers had to take care of the maintenance of the system. Clearing and minor repair works for on-farm ditches for tobacco planting (rather than for paddy) were carried out to ensure proper and efficient delivery and distribution of water to the fields. These works had to be done and finished early before planting activities started. They seek assistance from the NTB for any difficulty met during the course of doing maintenance work. For example, recently MARDI supplied them with a few bags of cement to be used in doing repair works to the concrete canals to overcome leakages at joints. This was intended to reduce production costs.

Land preparation involved tiling, ridging, furrowing and construction of field channels. Tilling and ridging were carried out by mechanical means. A curer would bring in their machines. Ridging needs trimming manually. Cost of land preparation would be deducted during sales.

The growers were not involved in producing seedlings. The curer arranged for seedlings to be brought in from a nursery situated outside Kampung Kekabu and distributed to growers. Seedlings of virginia flue cured tobacco of TAPM36 variety were used. Growers practice the single ridge system. Plant spacing is 1.02m between rows, and 0.56m within rows giving a population of 17,500 plants per hectare.

Figure 5. On-farm organization (dry season)



The application of fertilizer LTN1 for tobacco in the scheme is at the rate of 53 kg/1000 plants as recommended by the Malaysia Agriculture Research and Development Institute (MARDI) and the NTB.

LTN1 is composed of:

Nitrogen (N) - 20 (Kg/ha)
Phosphorous (P205) - 168 (Kg/ha)
Sulphate of Potash (K20) - 134 (kg/ha)
Magnesium (Mg0) - 27 (kg/ha)

The application of fertilizer took place in the scheme two to three days after transplanting. Growers are eligible to get 70% of the total cost from the NTB as subsidy. Pesticides were used to avoid pests (e.g. armyworms and budworms). Topping and suckering were carried out to increase root growth, weight, size and quality of leaf.

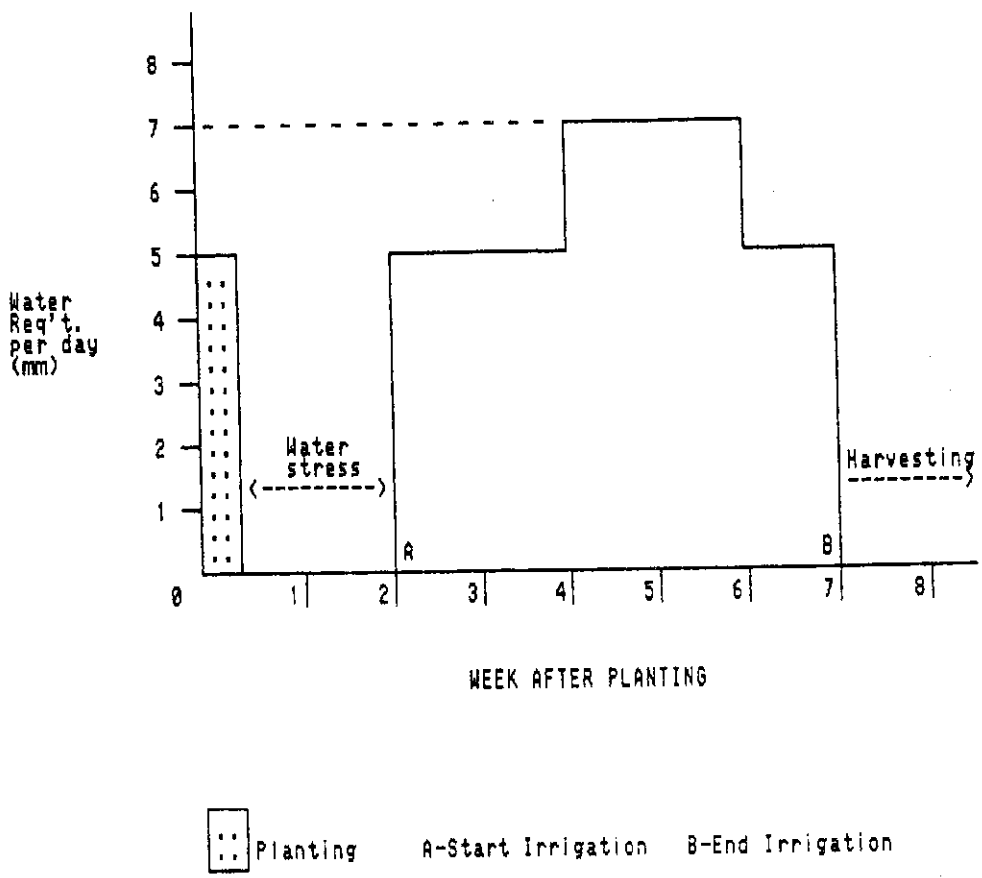
Operation of Pump

Operation of the pump was carried out by farmers. They elected a farmer amongst them who had been found to be willing to operate the pump throughout the planting season. The elected farmer had served and sacrificed himself as an operator for the past two seasons without being paid. He was proud of being elected as the operator. Since the pump is electrically motor driven, the operation is very much simpler and easier compared to a diesel engine driven pump. The operator had been trained by the DID before handing over the project to the NTB. Growers had to share electricity bills; which average M$1,000 per month. Through their past experience an average daily pumping of 3 hours in the morning (7 am. to 10 pm) and 1 hour pumping in the afternoon (3 pm. to 4 pm.) would be enough for irrigating their fields. However, this would depend on the weather.

The operation of field offtakes were carried out by farmers. The farmer nearest to the canal had to give more attention to the opening and closing of the offtakes. However the rest of the farmers must give full cooperation and should be easily available during his absence.

MARDI had to play an important role in giving technical advice to the grower as far as the application of water at farm level is concerned. The application of water depends on the growing stage of plants (i.e. planting stage, growth stage and harvesting stage). For Kampung Kekabu scheme water requirement is 5 mm/day during planting stage 7 mm/day at growth stage (50-60) days after planting) and 5 mm/day at harvesting stage. Again the application is not a daily affair. Much depends on the weather. (See Figure 5A.) Farmers had to ensure that their fields were not waterlogged. This situation could easily cause disease, for example root-knot nematode biologically, named Meloidogyne incognita.

Figure 5A. Water requirements for tobacco



The ripeness of leaves affect quality and yield of tobacco. Growers had to ensure that no underripe or overripe leaf is harvested. Harvesting period starts 50 days after transplanting and lasted for about 30 days. Green leaves are sold at the price of MR$65 (US$26) per kilogram (kg) to curer. For 1992, the average yield was 8,450 kg/ha., hence, this will give the average gross income of MR$5,500/ha. (US$2,200/ha). However, the production cost for tobacco amounts to MR$2,222/ha. (US$889/ha.). (Refer Table 1. Production Cost for Green Leaf). This would generate an average income of MR$3,277/ha. (US$1,310/ha).

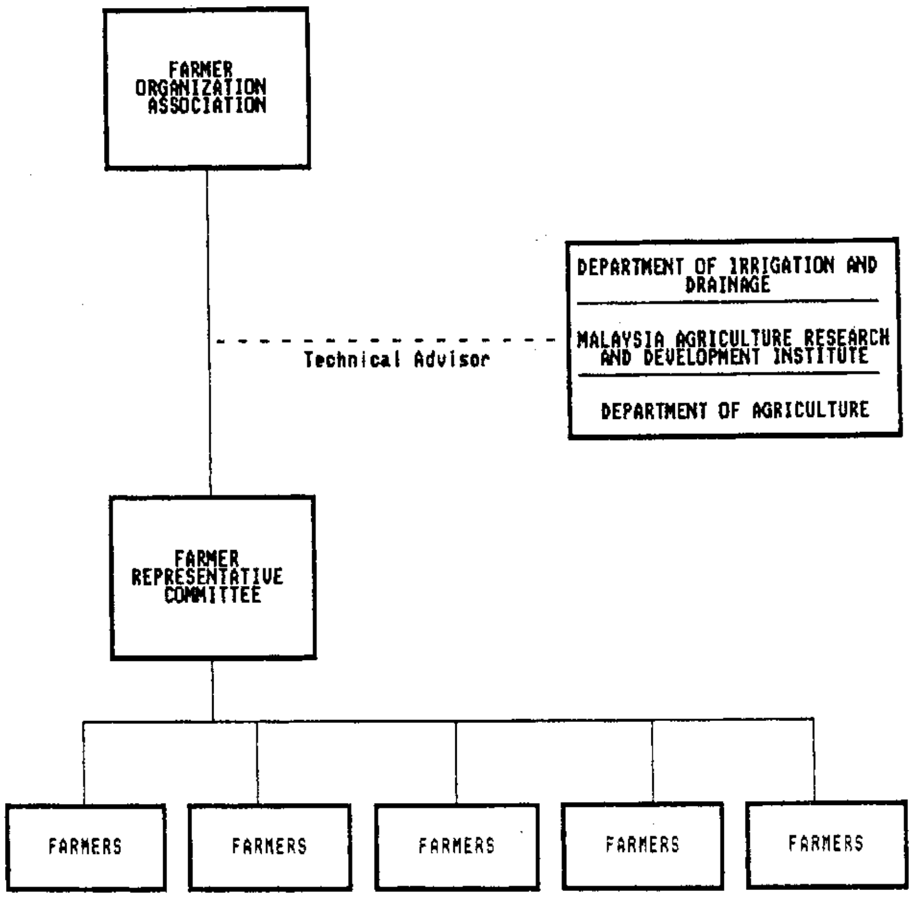
Table 1. Production cost for green leaf

ITEM		COST/ HECTARE ($)
A.	*Production of Seedlings*	
1.	Seed	0.88
2.	Chemicals for pest and disease controls	18.90
3.	Fertilizer	17.50
4.	Seedbed cover	92.75
5.	PolyPots "Kerek"	79.80
	Sub-Total	209.83
B.	*Growth Stage*	
		869.75
1.	Rent	227.50
2.	Fertilizer	174.83
3.	Chemicals for pest and disease controls	428.75
4.	Land Preparation	63.70
5.	Chemicals-sucker control	
		1,764.53
	Sub-Total	
		190.59
C.	*Equipments*	
		58.00
D.	*Electrical Consumption*	
		2,222.95
	GRAND TOTAL	

Management During the Wet Season

Paddy is grown during this period through the months of February to July. The farm organization during this period is as shown in Figure 6. The Farmer Organization Association (FOA) is the main agency to organize the group farming on paddy in the wet season. Eight farmers were elected among them to be their representatives in the Farmer Representative Committee and one was chosen as the leader. The leader convenes a meeting to fix the planting date, calling all the respective agencies involved. The committee (with the advice of agencies, i.e. the Department of Agriculture (DOA), FOA, DID and MARDI) make the decision and fix the planting schedule.

Figure 6. On-farm organization (wet season)



Since its operationalization, canal maintenance is very minimal. The drains were cleared through traditional "gotong royong" (donated labour) concept, where every farmer has to do their own share of work. Since paddy planting is carried out during wet season. pumping is only done as supplementary supply. The same operator was found to run the pump. Farmers are responsible for the operation of field offtakes. However, farmers nearest to field offtake have to give more attention to opening and closing them.

Average yield of paddy for 1991 was 3.5 ton per hectare. This was found to be much higher than before the project, which was 2 to 2.5 tons. The average yield would generate an income from paddy of MR$1,400 (US$56) per hectare. Farmers were free to sell their products to any buyer. However, a part of their products were kept for their own consumption.

Meetings or discussions are called by the organizing agencies as requested to discuss relevant matters or to solve problems which come up from time to time. Meetings or discussions facilitate communication between government agencies and farmers.

The present arrangement requires farmers to construct their own secondary earthen canal in order to deliver water from the main canal to the fields. Operating and controlling water in the secondary canal is difficult because it is earthen, which allows seepage and water overflow. To get a higher yield of tobacco the field must be free from water-logging. MARDI is carrying out a study on the possibility of using concrete canals at farm level for an efficient and effective water distribution.

THE NEED FOR AN INVENTORY

Some form of inventory for the scheme needs to be prepared and continuous monitoring needs to be done. Only then will the existing situation or problems of any FMIS be grasped and performance evaluation of the scheme can be carried out. Any early sign of shortfalls or weakness which arose in the system can be quickly detected and correct measures can be taken immediately. Information from the scheme inventory is also very useful and helpful to the government for further development of FMIS.

The scheme inventory similar to that developed by study on crop diversification and small irrigation schemes undertaken under a Technical Cooperation Programme between the Government of Japan (JICA) and Malaysia in 1989 can be adopted with some modification. It can be as a model of MIS for the FMIS. Farmer participation in the daily O & M, decision making and on-farm organizational structure are among the items included in the scheme inventory (see Table 2). Information for the Scheme Inventory shows the proposed general information and relevant data on FMIS.

Table 2. Information for the scheme inventory

MAIN ITEM	ITEM	SUB-ITEM
Overall	General	Scheme code number, name of scheme, location, type of scheme, year of completion, area of scheme, major towns nearby, accessibility.
	Socio-economy	Name, population, household number and farm household number of Mukim in which scheme is located;total number and landholding size of beneficiary farm household; landholding and tenure situations.
	Topography and soil series	Topography, elevation, ground slope, soil survey previously done, soil conditions, typical land use around scheme.
	Agricultural development project	Existence of on-going rural and agricultural development projects covering scheme; name, responsible agency and sponsorship of projects.
Facility	Water source	Name of water source river, river gauging station, diversion discharge, catchment area at diversion point, representative rainfall and meteorological station, quality of irrigation water.
	Irrigation water demand requirement	Designed discharge value, actual diverted discharge, situation and affected area of water shortage in normal year, main reasons of water shortage.
	Irrigation facilities	Type of diversion structures, headworks, pumphouse, intake structure at diversion site, total length of irrigation canal, structures, specific problems.
	Drainage and flood control facilities	Total length of drainage channels, drainage structures, drainage conditions, main reasons of poor drainage, area affected by floods, estimated flood damage, measures for flood mitigation with estimated costs.
	Farm road	Length and width of farm roads, surface pavement, specific problems, trunk road connected.
	Operation and maintenance	Annual O & M costs.
	Investment cost	Initial investment cost, major rehabilitation cost.

Table 2 (Cont'd.)

MAIN ITEM	ITEM	SUB-ITEM
	Water charge	Basic rate, situation of collection main reason of difficulty to collect water charge.
Cropping	Land	Land use changes and actual cultivated area for the previous five years, situation of idle land.
	Farming system	Farm operation system, cropping pattern, farm plot condition, use possession and rental fee of agricultural machinery.
	Crop production	Crop yield and total crop production for the previous five years.
	Crop budget	Farm gate prices and production costs of crops, specific problems against increasing crop production.
Supporting services	Post harvest facilities	Ricemill facilities, storage facilities, processing facilities other than tree crops.
	Agricultural support services association	Farmers' association, farmers' cooperatives, extension services, available credit services, farm input supply, selling of crops, specific problems concerning supporting services.

CONCLUSION

The Kampung Kekabu Irrigation Scheme sets a good example of FMIS that can be replicated elsewhere. Cooperation between government agencies and farmers plays an important role in system management. The participation of farmers in O & M can reduce the financial and management burden of the government. A good MIS is needed to monitor and evaluate FMIS performance for future improvement.

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Farmer Managed Irrigation Systems in Northern Thailand

Lek Prapasajchavet[20]

INTRODUCTION

In the Northern Part of Thailand, farmer managed irrigation systems (FMIS) or "Maung Fai" have been developed by local farmers living in small valleys employing traditional irrigation practices. Water rights have been observed not only among farmers who share water in the same irrigation system but also among upstream and downstream systems in the same sub-basin. The people irrigation system in this country has the command area ranging between 10 ha to 1,500 ha and there are about 2,039 projects.

Two FMIS, namely Mae Sao and Mae Chaem in the Fang and Mae Chaem watershed, were selected for this study. The project was established based on agreement with farmers. Water user can take water from the canal into their land, but the amount of water has to follow the area size, the source of water, type of crop, etc. These projects had more advantages over the national irrigation project. The smaller works were more efficient in administrating the work of the committee. Other advantages include case in accepting and following project regulations.

GENERAL

Thailand is an axe-shaped land. The total land area is 513,000 Sq.km. with 50 million inhabitants. Topographically, Thailand has three types of land forms: highlands, plains, and plateaus. Highlands include several mountain ranges mostly covered with forest that extend from the Northern to the Peninsula through the entire western length of the country. In the North, the mountain ranges form the four (4) principal basins drained off by the Ping, Wang, Yom and Nan Rivers. The four rivers, of course, are considerably steep varying from 1:500 at the head water to 1:1,000 at the middle reaches and to 1:5,000 at the lower reaches. These valleys form flat plains intermittently along the rivers as places of settlement for the inhabitants and for agriculture on a subsistence basis.

Area classified as farm holding land totals about 23.5 million ha. The present accumulated irrigated area is 4.2 million ha or 17.8 percent of farm holding land. The people irrigation project was originated in the North a long time ago. The area of each project is between 10 to 1,500 ha. There are 2,039 projects at present with a total area of about 100,000 ha.

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HISTORY OF PEOPLE'S IRRIGATION SYSTEM IN NORTH THAILAND

In the old days, the people in this region were quite familiar with the construction of diversion irrigation systems, but there are few records available to substantiate this. Under the suzerainty of the late Khun Mengrai, who had full influence over the Mae Ping Valley in B.E. 1820, there legislation was enacted for water use for diversion irrigation systems, with heavy penalties being inflicted on offenders. In order to conserve as much water as possible for use during the rice growing season, the inhabitants found it necessary to divert river water by means of weirs to elevate the meager flow of water to such a height that can be passed into "Muang" or irrigation canals. Weir made by local efforts were made of construction materials of a non-permanent nature, such as bamboo or "Mai Lam" (a kind of hard wood but of small stems) driven into the river bed in rows, and packed with sand and gravel to the required elevation. In some places, the elevation is 3 meters from the bed of the river. Since the main structure of the weir was bamboo, which is used as piles, the weirs was called "bamboo weir". From these canals, water is diverted through ditches to the field. This activity has become the traditional practice among the northerners to construct and repair the irrigation work every year. Traditionally, they elect an elderly member of community as chief of the system, called "Gae Muang". The duty of this person is to call upon the people to contribute their share of manpower. In some cases, the people have been asked to contribute bamboo or other kinds of hardwood to be used for the weir. There were also voluntary contributions of manpower from among the water users to dredge shallow parts of the irrigation channel before the start of rice growing season. In cases where shortage of water occurs, the "Gae Muang" is the person to make a decision on how much water ought to be apportioned to each farmer.

There are also other types of irrigation systems employed, other than river diversion weirs. In places where there are rapid streams, water wheels for irrigation are also installed. These wheels are generally made of bamboo, with bamboo buckets fixed to the periphery. As the wheels go around by the force of the current, these buckets convey water to the top of the wheel and topple it into a bamboo trough which sends it to the land to be irrigated.

INSTITUTIONAL TYPES OF FMIS

The three arrangements for FMIS are 1) small individually-developed schemes; 2) farmer group schemes; and 3) contractually developed and/or managed schemes. Under the latter arrangement, persons contract to others to develop and/or maintain irrigation schemes for payment. Contractors receive authorization or concessions from the Government. Under the old concession system, the number of diversion irrigation works multiplied considerably, but later these types of systems became unpopular due to the concessionaires not obtaining sufficient renumeration as originally expected. So the people were not able to obtain full use of water as required. The water rate was usually paid in the form of cash or paddy in proportion to the area irrigated.

GOVERNMENT AID TO PEOPLE'S IRRIGATION SYSTEMS

With the increase in population, new areas have to be gradually opened up. Following this development, the number of FMIS has increased. But as each of the systems can irrigate only a small area, diversion irrigation systems tend to be in close proximity to one another along rivers. In the absence of a canal head regulator to regulate the water supply, and the irrigation channel being too wide, systems which are located near the upper source of supply always draws more water than necessary while systems at the downstream usually suffer from shortage of water. When available water supply is small, there is no surplus water to be spared for downstream systems. It is during this time that water conflicts occur.

As regards the weir in the main river, the flanks of the weir joining the banks are often scoured out to the extent that new channels are created, causing difficulty in constructing a new weir at a new site.

In order to improve the situation and alleviate the hardships of FMIS the Government has given aid in improving irrigation works which could be categorized into four types as follows:

> *State Irrigation:* This type of assistance is expected to bring lasting benefit to the farmers. The time needed for completion of this type of work is three to five years. Construction and maintenance is implemented by the Royal Irrigation Department for generally large-scale systems.
>
> *Partial State Irrigation*: This type of work is a joint venture between the Royal Irrigation Department which is responsible for constructing the headworks for irrigating and regulating the diverted water into irrigation channels and farmers who develop the main canal, distributaries, and minor structures. As regards operation and maintenance, the Royal Irrigation Department is responsible for operation at the headwork only.
>
> *New FMIS Projects which the Royal Irrigation Department developed:* These are small projects that requires one tothree years to complete. When completed, they are turned over to the local authorities, who in turn appoint a group from the community to operate and maintain the project by themselves.
>
> *FMIS for which funds have been made available to the district and provincial authorities to carry out the work by themselves:* These are small projects for emergency or small repairs. The Government helps where the people cannot furnish materials or do the work by themselves, otherwise they are allowed to proceed with the work at their initiative. This type of irrigation assistance will be of benefit to the people for one or more years. The area benefited under each work is small and benefits only a part of the community.

EVALUATION OF MAE SAO AND MAE CHAEM PEOPLE IRRIGATION SYSTEM

For the purpose of documenting the socio-technical arrangements and problems related to irrigation, an inventory of the two FMIS was conducted. This method identified key physical, agricultural, technical and institutional features and problems in the two systems.

Project Area: Mae Sao project is in Mae Sao District. Mae Chaem is in Hangdong District in Chaing Mai Province (See Figures 1 and 2), covering areas of about 250 ha and 600 ha, respectively. These projects were initiated by the local people more than 100 years ago. The head works are temporary weirs which were constructed by local materials. The people have to undertake repairs every year because of floods during the rainy season. There is one main earth canal per project which divert water for agriculture and domestic use (Table 1).

Figure 1. Mae Sao People Irrigation Project Mapping

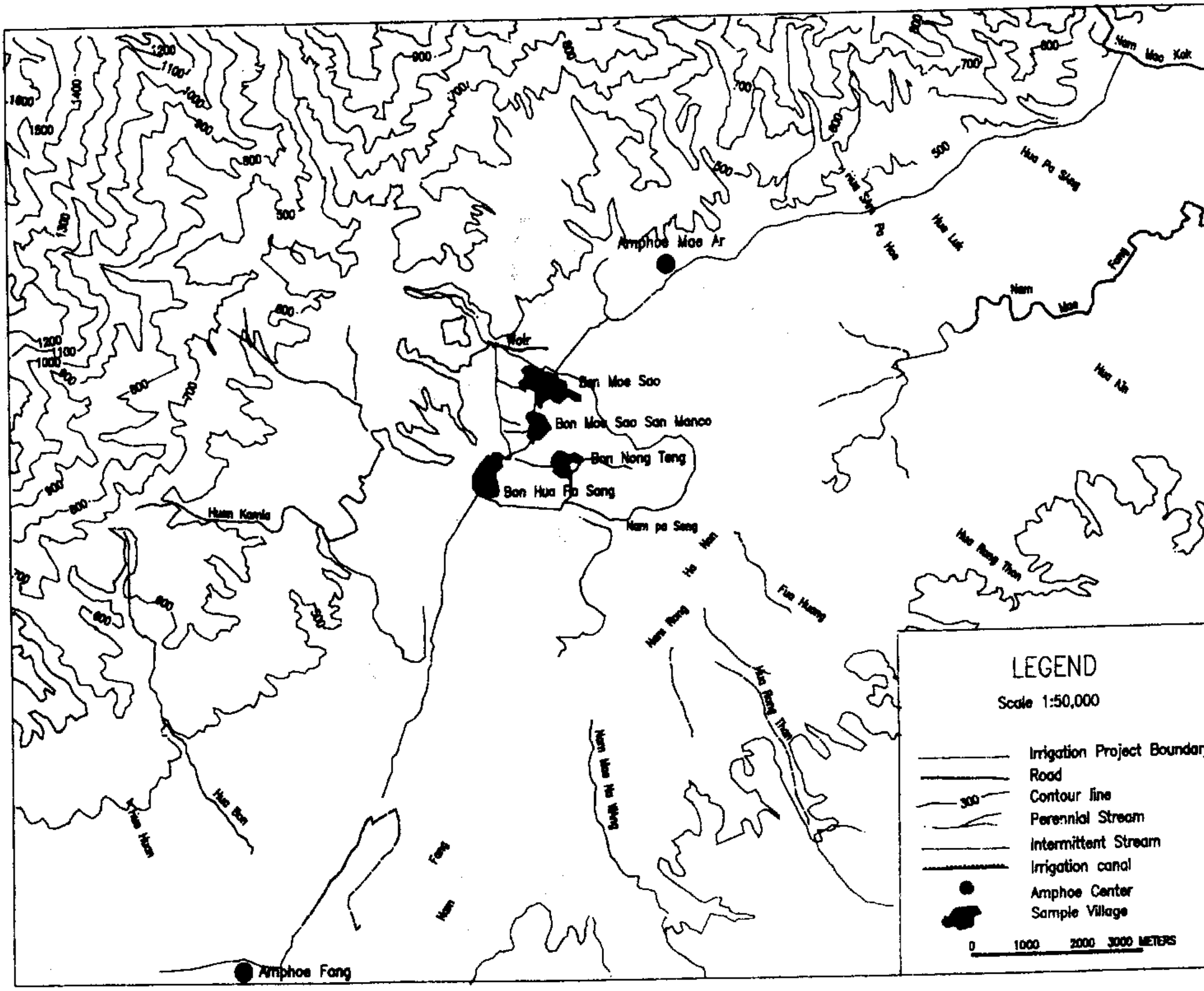


Figure 2. Mae Chaem People Irrigation Project Mapping

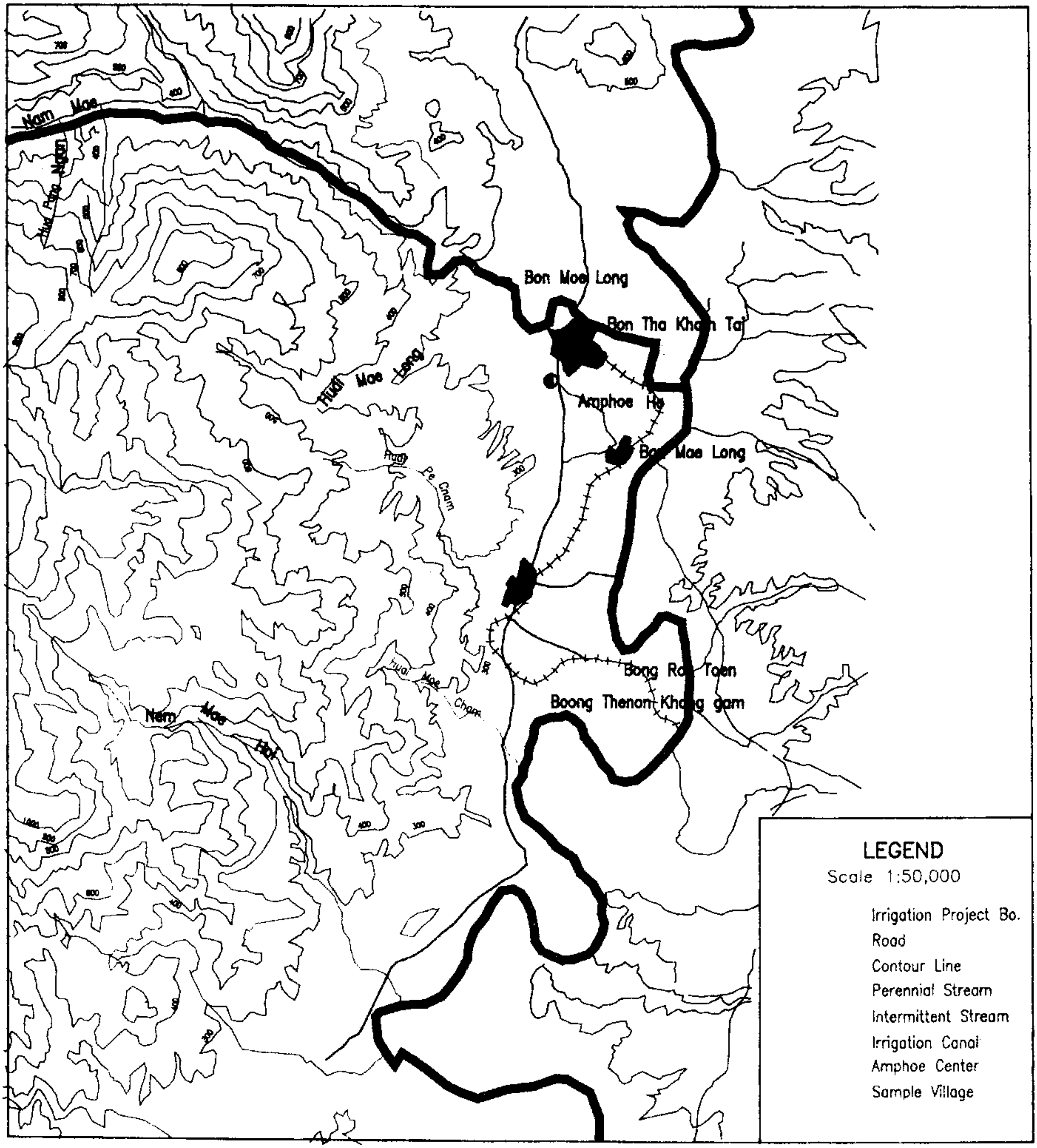


Table 1. Inventory data on Mae Sao and Mae Chaem People's Irrigation Projects

Inventory Data	Mae Sao	Mae Chaem
Head work	Diversion System	Diversion system
Type of weir	Bamboo	Bamboo
Construction	Local people	Local people
Person staff	12	12
Irrigated area:		
Wet season (ha)	237	590
Dry season (ha)	237	590
Cropping pattern:		
Wet season	July - September	July - September
Dry season	December - June	December - June
Check structure	24	24
Ditch intake	10	33
Canal type	Earth	Earth

Purpose of Evaluation: The evaluation of farmer performance in these two people irrigation projects has the following purposes:

a) to gain knowledge about traditional practices of people irrigation systems;

b) to analyze conflicts on water use among farmers and their mechanisms to resolve them; and

c) to compare the activities of water management between peoples' irrigation systems and national irrigation systems.

Basic data was collected through the use of questionnaire and direct interviews of 300 farmer families.

The organization of Peoples' Irrigation System: The general organization of peoples' irrigation project is shown in Figures 3 and 4. Usually, it is headed by the chief and vice chief of the users association with committees at the village level. Differences in the organizational set-up between Mae Sao and Mae Chaem are attributed to their topography, catchment area size, source of water, etc. (see Figures 5 and 6). The chief, who is selected by water users, receives water from the same source, receives no salary, and is responsible for several tasks including; enforcing agreements among water users, allocating water among farmers, checking damage to structures and developing the yearly repair work schedule and imposing fines on offending farmers. In Mae Chaem there is always water shortage during dry season, so the organization is more complex than for Mae Sao. The water users assemble and repair the head work and canal by using simple equipment and local materials.

Figure 3. Chart of the Organization of People's Irrigation System

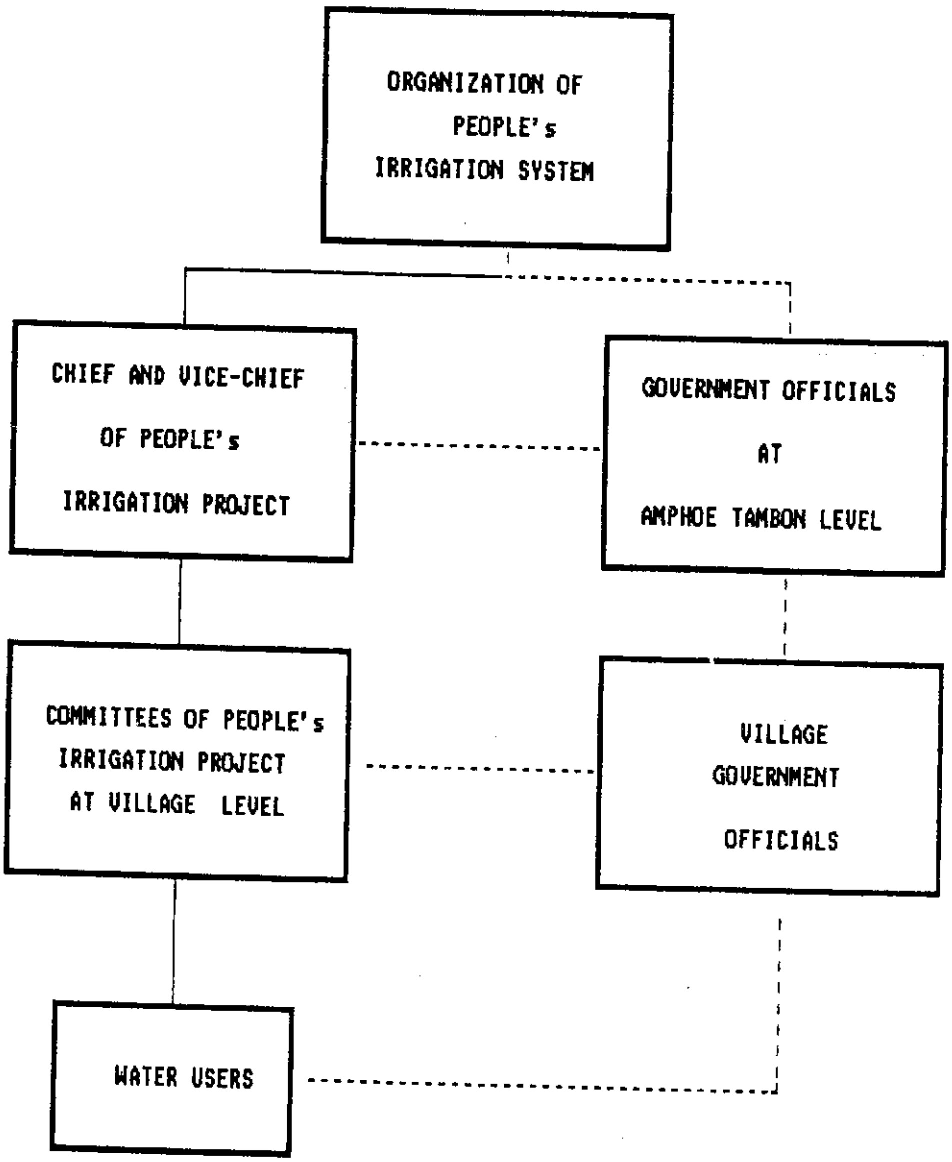


Figure 4. Chart of the Organization of Irrigation System

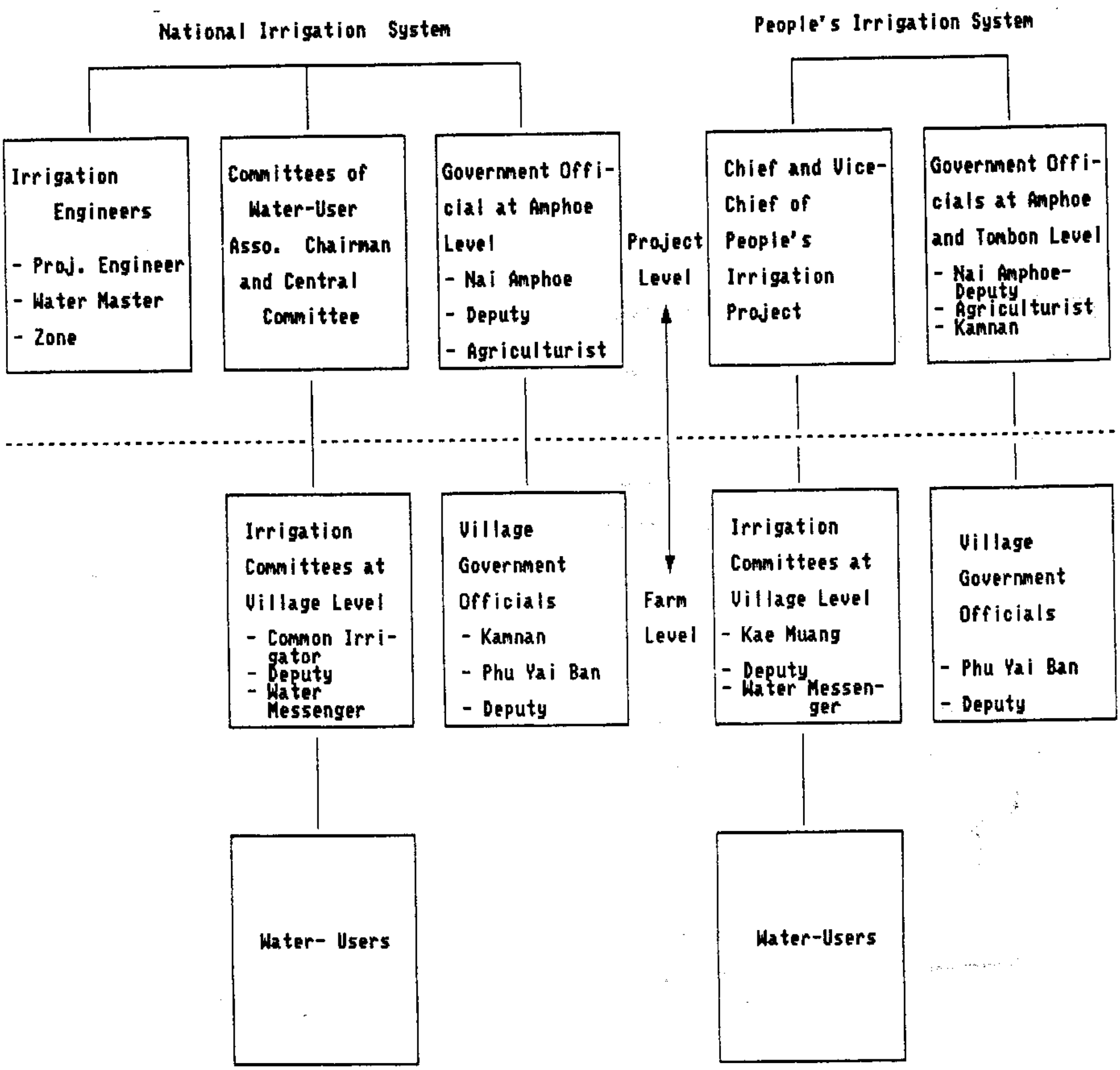
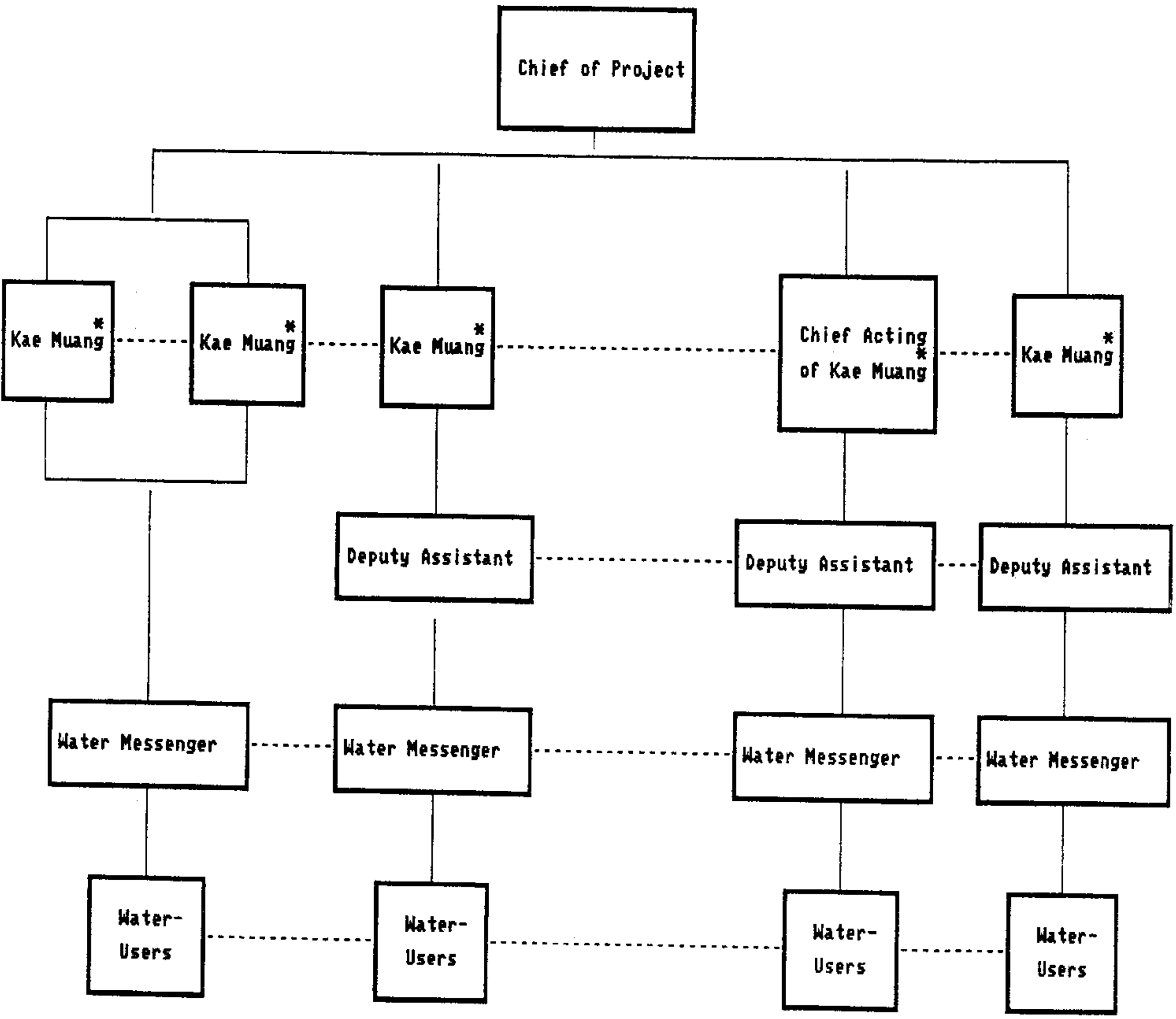
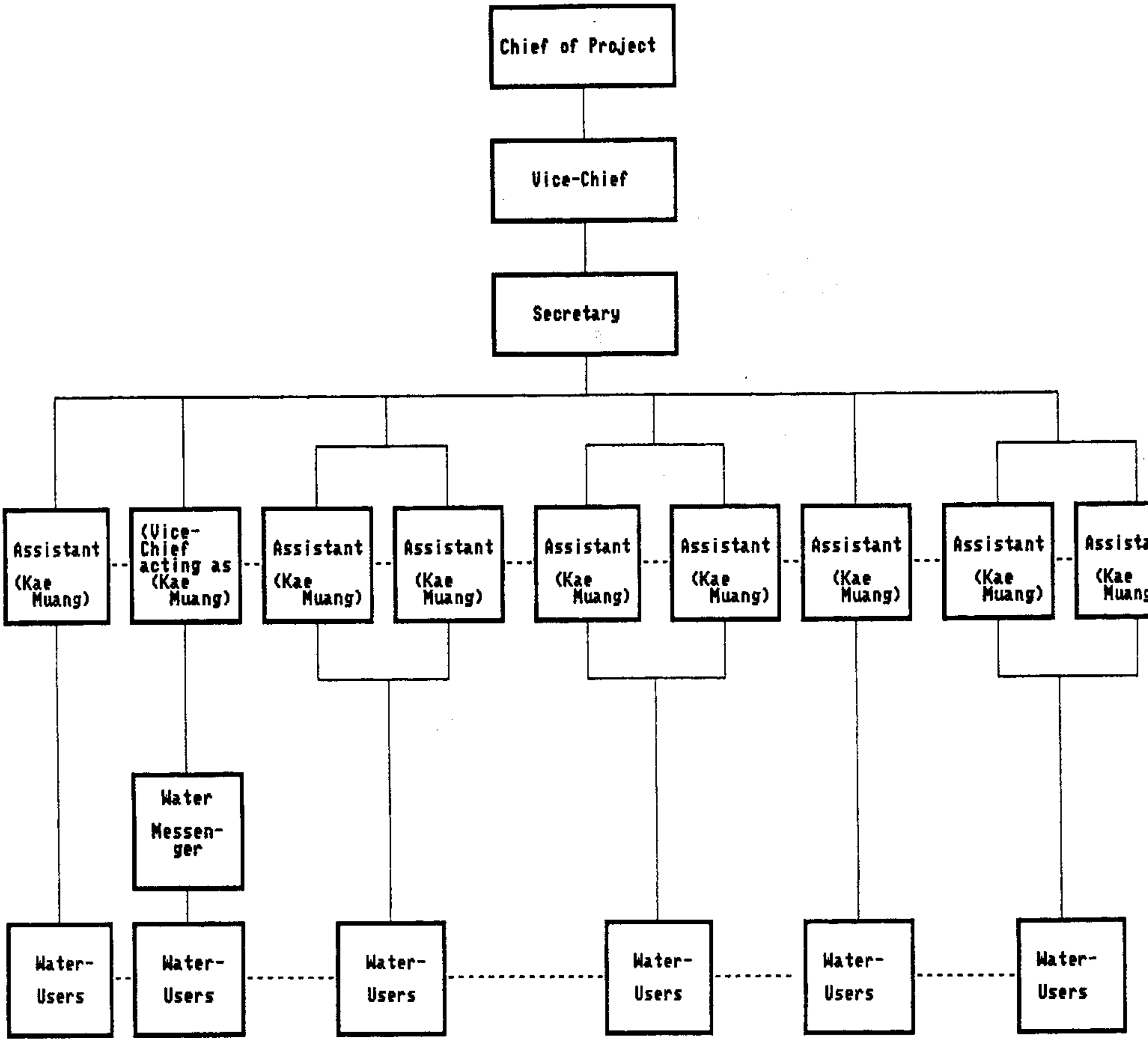


Figure 5. Chart of the Organization of Mae Sao People's Irrigation Project



* Kae Muang = Assistant

Figure 6. Chart of the Organization of Mae Chaem People's Irrigation Project



Yearly Crop Pattern: The yearly crop patterns for Mae Sao and Mae Chaem are illustrated in Figures 7 and 8. The main crops of Mae Sao project are glutinous rice, soyabean and tobacco. In Mae Chaem they are glutinous rice, white rice, soyabean, groundnut, mungbean, garlic and onion.

Figure 7. Crop Calendar of Mae Sao People Irrigation Project

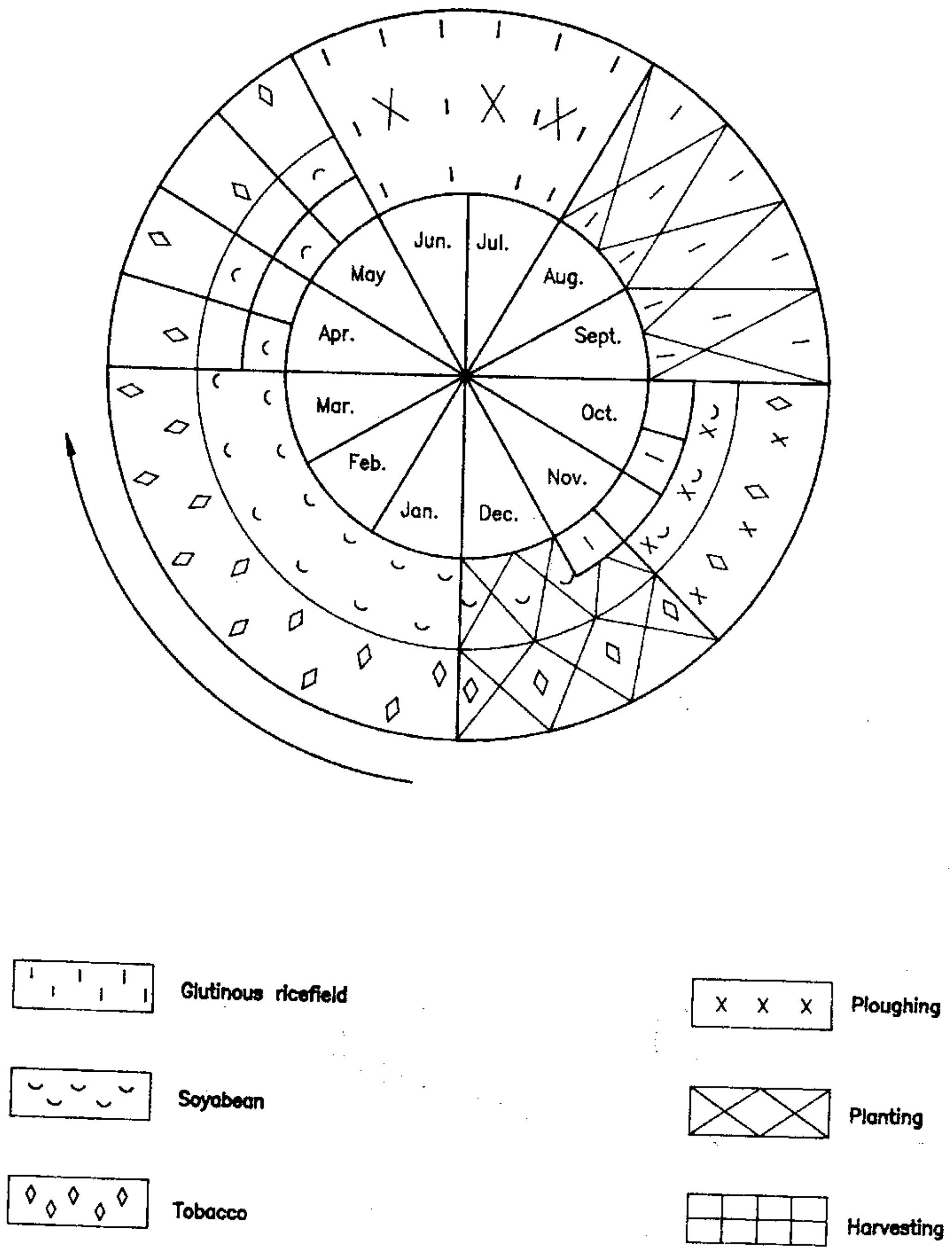
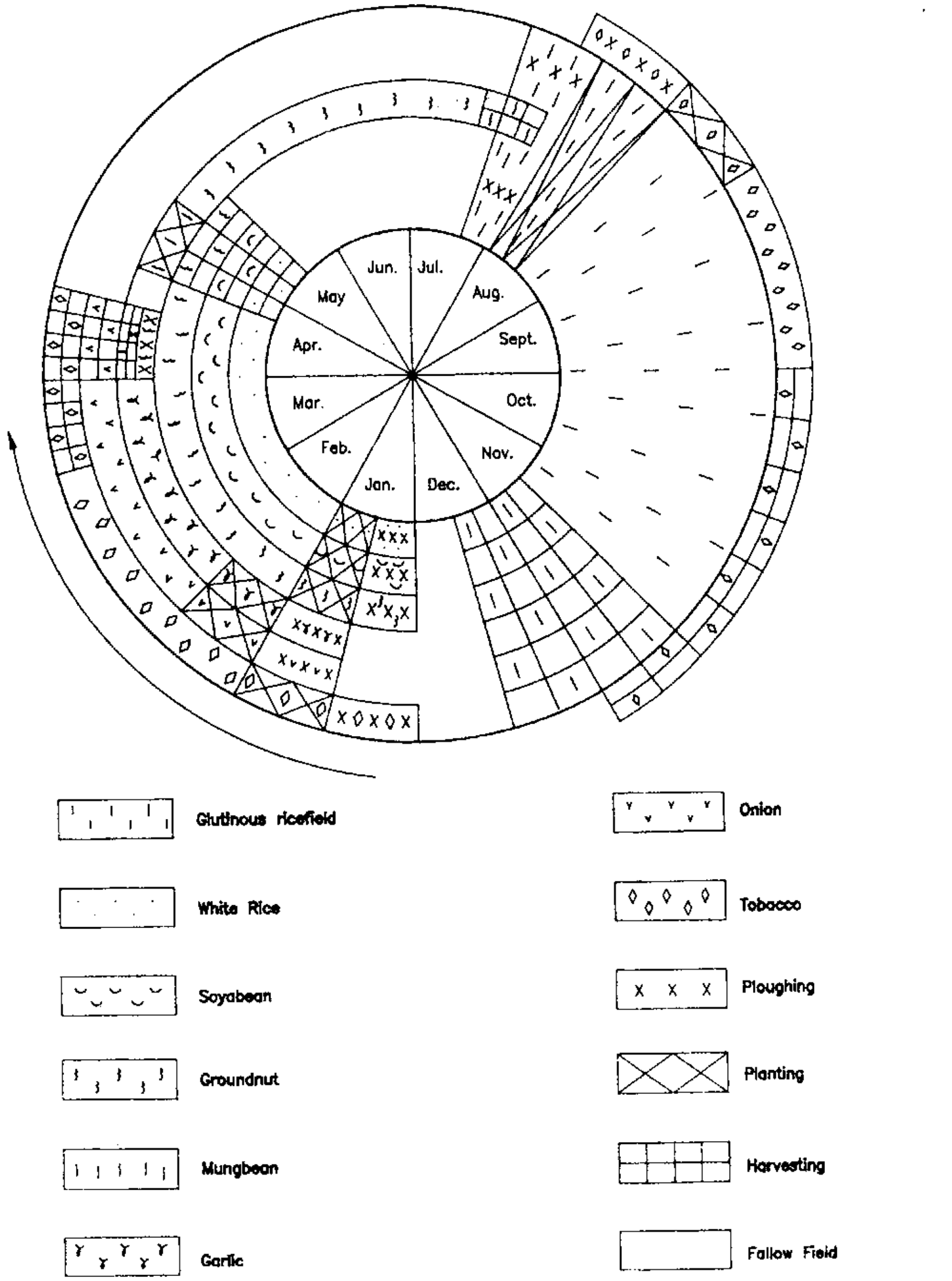


Figure 8. Crop Calendar of Mae Chaem People Irrigation Project



Farmers negotiate among themselves about the most suitable crop to be planted. They consult each other in order to avoid conflict. The chief suggests to water users a crop that is appropriate to the given area. The average area size per family is about 1.3 ha and 0.86 ha for Mae Sao and Mae Chaem. The farmer can grow crops without area limits during the wet season.

Conclusion: The major characteristics identified from the inventory study in both irrigation systems can be summarized as follows.

a) There are conflicts between farmers located in the upper and lower parts of the canals and the committee of the water users associations is a reasonably effective tool to solve these conflicts. The chief of the water user group can help minimize the conflict by apportioning or rotating water use among the farmers. This conflict management system seems better than in national irrigation system.

b) Although the farmers can grow crops fully during the wet season, they are usually faced with another problem, flooding. The average flood damage in the past years reaches about 60 percent of the total production. On the other hand, drought is a problem during the dry season with average damage estimated to reach to about 40 percent. Both of these problems occur because of no water storage in the system.

c) The intake regulator is required to control water into the canals of the systems because the natural flow is less than water demand in dry season.

d) The requirement for weir maintenance per household in Mae Sao is 3 average man-days. In Mae Chaem it is 10 average man-days.

e) The requirement for canal maintenance per household in Mae Sao is 4 average man-days. In Mae Chaem it is 27 average man-days.

f) The viability of independent FMIS will become less in the future because of keen competition among farmers. High level coordination and regulation of water use between FMIS along river basins will become more and more important.

g) The crop pattern in FMIS has to be changed to follow market demands. New cultivation techniques should be introduced to the farmers.

Farmer Managed Irrigation Systems Inventory: Experiences and Lessons from Nepal

Dharma R. Tuladhar, Ujjwal Pradhan and Hari Man Shrestha[21]

INTRODUCTION

This paper reviews Nepal's attempts at conducting inventories of FMIS and extracts lessons applicable elsewhere. During the past decade several institutions within Nepal have undertaken irrigation resource inventories. While one such inventory by the Water and Energy Commission (WECS) has been a nation-wide inventory, others have focused on a single river basin (WECS-IIMI), a valley (IAAS-IIMI), administrative district (Dhading District Development Project/GTZ), or thematic concern like common property arrangement (Indiana University). The experiences gained and lessons learned from such inventories are definitely applicable to many other agrarian societies.

The WECS inventory has been conducted so far in 59 districts indicate that around 3,172,000 ha area is under cultivation, out of which 947,610 ha of land is irrigated (mostly seasonal) and the rest is rainfed. Out of the irrigated land, 688,740 ha is irrigated by farmer managed systems and 258,870 ha of land by government managed irrigation systems. The number of farmer managed systems as identified by the inventory are 10,019. The numbers of government assisted farmer systems and government managed systems together total 411. It is to be noted that in the Terai plain area (covering 20 districts) systems with less than 25 ha and in mountain areas systems with less than 5 ha or 2 ha, depending upon topography have not been included in the inventory.

A river basin irrigation resource inventory was undertaken by WECS with assistance from the Ford Foundation and the International Irrigation Management Institute. An inventory activity was undertaken in the Upper Indrawati River Basin in Sindhu Palchok District to determine relative needs for assistance among systems and to establish criteria for selecting systems to assist. For such selection criteria to be established, it was necessary to identify all the systems in the basin and collect minimal information about each of them. The inventory also relied on farmers' knowledge for the variations of discharge in the stream at the diversion in each season, area irrigated for each crop, extent and nature of unirrigated land that could be served by each canal and also the reasons why it was not presently receiving water. The inventory identified 119 irrigation systems with canals longer than 0.5 km. in the 200 sq. km. area irrigating about 2,100 ha owned by more than 5,000 households. An important accomplishment of the inventory was a description of the potential for either intensifying the cropping pattern or expanding the area irrigated by each system. For example, out of the 119 irrigation systems, it was found that only 23 separate irrigation systems had both land and water resources with potential for expansion of the irrigated area.

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Drawing upon these and other inventories undertaken in Nepal, the paper presents i) the rationale or need for inventories, ii) the different types of inventories and their comparative advantages and utilities, iii) methodological issues in use of inventories, iv) the need to incorporate institutional and sociological variables or indicators into inventories (e.g., water and land rights, irrigation organizational capacities, availability of local resources and support services, etc.), and v) the relevance of the Nepal experience to FMIS inventory in general.

This paper concentrates on the inventorying experiences of WECS and DDDPGTZ, which we consider to be the most innovative and experiences. The Nepal nation-wide water use inventory study has to date been undertaken by WECS for 59 districts out of 75. The river basin irrigation water use inventory was undertaken by WECS with assistance from the Ford Foundation and IIMI-Nepal. This inventory activity was undertaken in the Upper Indrawati River Basin in Sindhu Palchowk District to determine relative needs among systems and establish criteria for selecting systems to assist. The other inventory described here is the one undertaken by DDDP/GTZ in the administrative district of Dhading.

Drawing upon these inventories undertaken in Nepal, the paper shall present i) the rationale or need for inventories, ii) the different types of inventories and their comparative advantages, iii) the methodological issues in inventories, iv) the need to incorporate institutional and sociological indicators for the inventories, and v) the possible relevance of the Nepal experience to FMIS inventory in other parts of Asia.

This paper will first describe the three types of inventories undertaken, namely: nation-wide, river-basin and administrative district and presents lessons learned from these inventories. The latter part of the paper will focus on certain issues pertaining to irrigation inventory and its possible relevance elsewhere.

CONTEXT OF IRRIGATION INVENTORY IN NEPAL

Water plays a very important role in Nepal's economy which is predominantly agricultural. The history of systematic introduction of government irrigation systems in Nepal is recent but farmers of this country have been using water for irrigation since time immemorial. More than 90 percent of the small and medium scale irrigation systems or about 75 percent of the irrigated area in Nepal were created, managed and operated by farmers themselves. But, unfortunately, proper records of such systems have not been kept. Without the proper knowledge and information about the existing situation in irrigated areas and uses of the water sources, it has become difficult for development planners in Nepal to make well-informed and sound decisions on whether to emphasize construction of new irrigation systems, to rehabilitate, to improve or to extend existing systems. The rapid population growth both in rural and urban areas has increased the demand and competition for water resources. This scenario could be a source of conflict not only for local communities wanting to use the same source of water but also among the *"co-riparian"* countries. Thus, it was realized that proper record keeping of water uses location-wise and time-wise was of utmost importance.

In view of the Nepali context where the major use of water is in the irrigation sector, studies that brought about the collection, compilation and systematic management of information for water use were first focused on the irrigation sub-sector. The Water and Energy Commission Secretariat (WECS), an advisory commission of His Majesty's Government of Nepal, started a *"Water Use Inventory Study'* program in 1984. This inventory study was conducted district-wide with the objective of covering the whole country. This program is still continuing and, as mentioned above, 59 districts have already been inventoried.

During the course of this nation-wide inventory, the need for an action-oriented research program to identify cost-effective ways and means for supporting farmers to improve their irrigation systems was also felt. Therefore, a priority listing of systems for improvements had to be made. This meant the preparation of an inventory of farmer irrigation systems and their characteristics. This was later carried out within a selected river basin. This inventory will be dealt examined below in this paper.

WECS carried out two different types of inventory studies with different purposes. The purpose of one inventory study was to create a comprehensive data base on existing irrigation systems on a nation-wide basis. The other purpose was to create a basis for selecting farmer managed systems along river basins on a priority basis. Another purpose was to develop and test methods, techniques, and technologies for assisting existing farmer-managed irrigation systems in a cost effective manner in the form of an action research program.

Similarly, DDDP/GTZ initiated Dhading District inventory study with an objective to generate information for assisting the central as well as the district level agencies to effectively plan and implement small-scale water resource development. This study focused on and intensive inventory of all rivers and streams along which irrigation systems and hydropower have been developed in only one district.

BRIEF DESCRIPTION OF THE NATION-WIDE INVENTORY OF IRRIGATION SYSTEMS

The objective of the nation-wide inventory were: i) to identify existing or planned uses of water with particular emphasis on irrigation use (including the identification and provision of preliminary information regarding the scope and nature of potential projects, ii) to acquire preliminary information on the technical, institutional and performance aspects of the irrigation systems, iii) to identify the sources of water with emphasis on river/stream water resources and iv) to assess approximately the quantity of the sources of water.

Collection of all relevant secondary materials, maps and aerial photographs of the study area were undertaken. Maps were studied for identifying the probable sources of water in the study area. Identification of the existing irrigation systems and the land use pattern in the study area were carried out with the help of aerial photographs and cadastral survey maps. The suitability of land for agricultural production was determined by the use of land capability maps.

An index map of the study area was prepared by incorporating all this information in which the irrigation systems identified by the aerial-photo interpretation were also located. In short, the secondary materials collected focused on information regarding the irrigation systems, hydrology and agriculture.

After assessing and arranging the necessary data for a particular district, the field survey work was carried out in order to verify information and up-date it or add missing information, including present cropping pattern. Identification of existing traditional irrigation systems, agency built and managed, or locally constructed and managed irrigation systems was done with the help of the index map prepared during the desk study stage.

Verification and checking of the systems was undertaken by the study team by visiting each system and making necessary corrections in the index map. Generally, more irrigation canals were found in the field than were identified by aerial photo interpretation and there was about 20 to 25% error in their interpretation. Measurement of discharge in the rivers and canals were done wherever possible.

After analysis and verification of information collected during the desk and field survey, a comprehensive district water use inventory report was prepared containing particularly the comparative study of available discharges of the rivers, existing water use by irrigation and water balance available for downstream use. During the study, an irrigation system network map also was prepared and annexed to the report.

PRESENT STATUS AND RESULTS OF WORKS ALREADY COMPLETED

Out of 75 districts of Nepal, 59 districts have already been inventoried by this study. The districts for which inventory reports are available are shown in Figure 1. The study in the remaining districts is continuing. After completion of district inventories, they will be arranged into a nation-wide inventory arranged by different basins.

The inventory study conducted so far in 59 districts indicated that around 3,172,000 ha is under cultivation. Out of the irrigated land 688,740 ha is irrigated by farmer managed systems, 258,870 ha is irrigated by government developed irrigation systems. The number of farmer managed systems, as identified by the inventory study, is 10,019. The number of government assisted farmer systems and government managed systems together total 411. In the Terai (covering 20 districts) systems with less than 25 ha and in mountain areas the systems with less than 5 ha or 2 ha (depending on topography) have not been included in the inventory.

From the point of view of agricultural production, the terai is considered the granary of the country. Out of 947,610 ha of irrigated land as identified by the inventory study, 760,226 ha are in the terai and 187,384 ha in the hills. Meanwhile 69% of the irrigated area in the terai and 87% in the hills is irrigated by FMIS (see Table 1).

Figure 1. Location map of the area covered by inventory

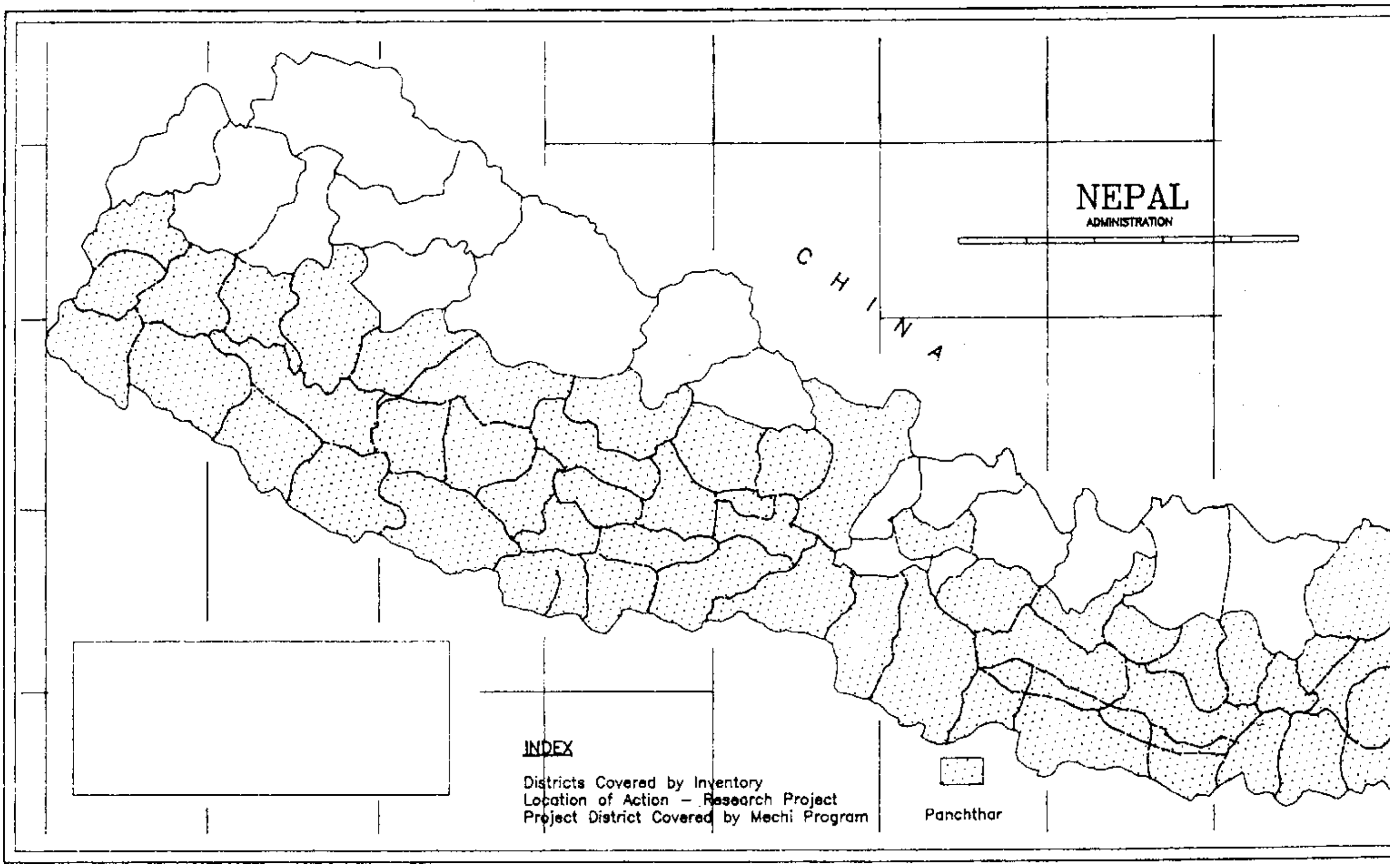


Table 1. Summary of nation-wide inventory

Numbers of Districts Completed	59
Total Cultivated Land (59 Districts)	3,172,800 ha.
Total Irrigated Land (59 Districts)	*947,610 ha.*
FMIS irrigated land	688,740 ha.
Government Managed System	258,870 ha.
Total Nos. of FMIS (59 Districts)	10,019
Total Nos. of Government Managed System	411
Total Irrigated Land in the Terai Region (20 Districts)	760,226 ha.
Total Irrigated Land in the hills (39 Districts)	187,384 ha.
Percent of Irrigated Land Covered by FMIS:	
Terai	69%
Hills	87%

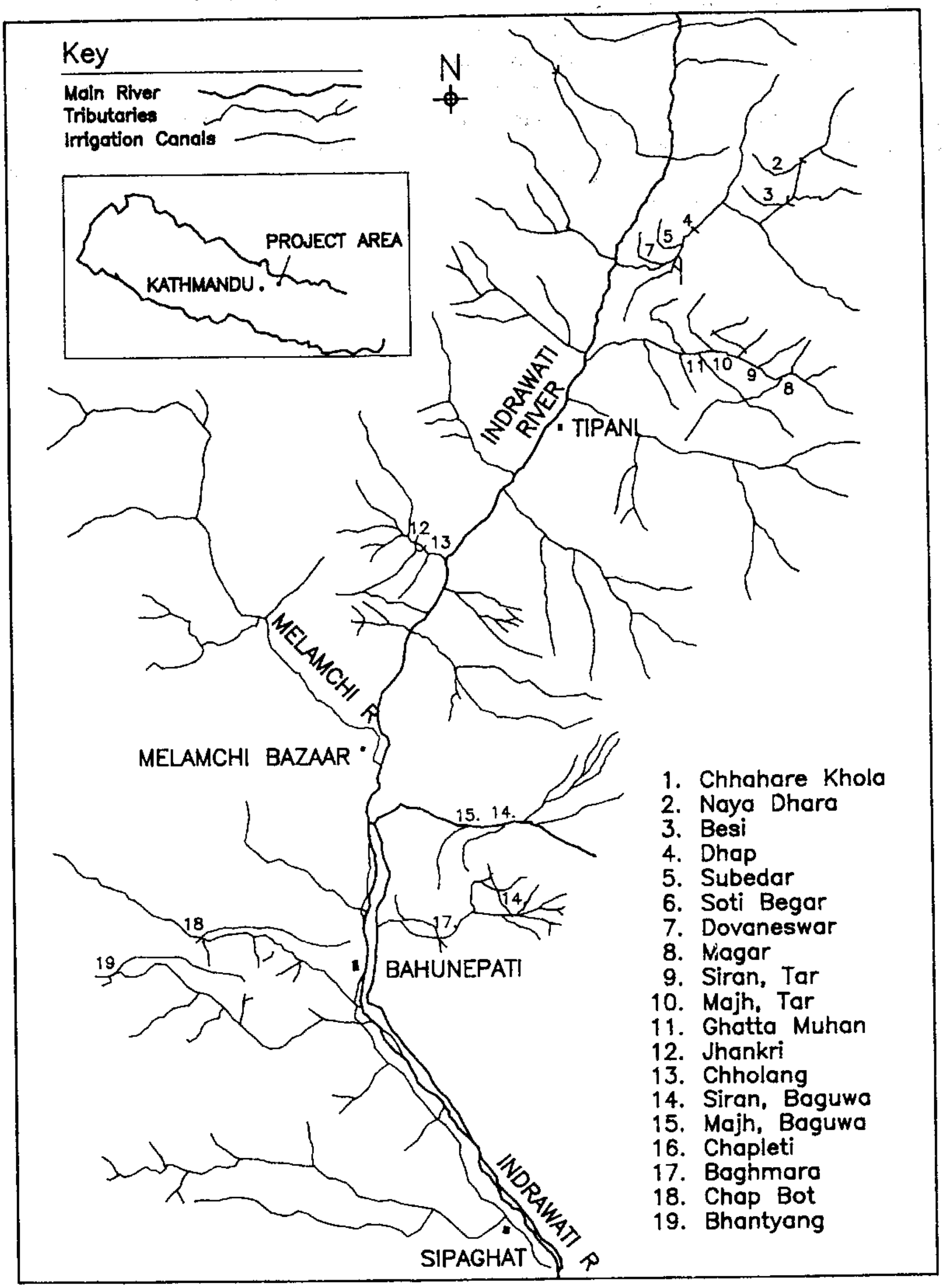
The above figures show the importance of farmers' contribution in the development of irrigation in Nepal. As a matter of fact, most of the command areas covered by the government managed systems also include the areas already irrigated by farmer systems. Planners and decision makers have to think whether new projects are to be undertaken on a priority basis or concentrate on assisting the already existing farmer systems to strengthen their management and expand the command area through augmentation of the water flow. In this regard, the inventory study has been considered as the basic source of information for use in selection of the projects to be improved, rehabilitated, strengthened and/or expanded.

AN ACTION-RESEARCH PROJECT

Keeping in view how assistance could beprovided to existing farmer irrigation systems that it would have the maximum impact on agricultural production at least cost, WECS with the assistance from the Ford Foundation and the International Irrigation Management Institute (IIMI) undertook an inventory of irrigation systems in the upper Indrawati River Basin aimed at selecting appropriate systems for an action-oriented research project (Figure 2).

One objective of the action-research project was to establish low-cost procedures for identifying the relative needs of all systems in a particular area, allowing selection of systems for assistance where greatest impact on food production could be made (WECS/IIMI, 1990). Another objective was to develop and test methods for providing assistance that enhance farmer management capability for operation and maintenance without eroding *"farmer management"*, especially if physical infrastructures were being improved.

Figure 2. Location map of improved FMIS under action research project



Source: WECS/IIMI. 1990

The work was divided into two phases. In the first phase, a field-based reconnaisance to produce an inventory of all existing systems was carried out. The inventory included important information about the problems each systems faced and particularly the extent to which the land and water resources were being utilized. This information was collected by visiting each canal from the diversion to the command area with a group of water users. An assessment of available discharge in the stream throughout the year was also made by using farmer informants to describe the variation of discharge in each season compared to that being observed. As a result of the inventory study, 119 irrigation systems were identified with canals longer than 0.5 km in the 200 sq. km. project area. These systems irrigated about 2,100 ha and land was owned by more than 5,000 households. A major accomplishment of the inventory was a description of the potential for either intensifying the cropping pattern or expanding the area irrigated by each system. Out of 119 irrigation systems identified, only 23 separate irrigation systems were identified as having both land and water resources with potential for expansion and improvement of irrigation area.

An additional rapid appraisal of the selected systems was carried out to identify the specific problems of each canal and to begin the process of identifying the type of assistance the beneficiaries felt useful. A complete profile of the existing agricultural and irrigation practices, water rights, sociological variables and the mechanism for operation and maintenance activities of the canals was developed. Finally 19 systems out of 23 were selected for assistance.

The second phase of the project implemented the *"improvement works"* of the selected canal systems. The rapid appraisal report identified more work to be done than the available project money. Hence, the improvement work was divided into three categories: (i) first priority work that was essential for expansion but difficult for farmers to do without assistance, (ii) second priority included work desirable for improved operation and maintenance, and (iii) third priority work as identified as improvements farmers could accomplish with their own resources. The details of this implementation process with continuous dialogues negotiations and bargaining are described in WECS-IIMI, 1990. Tables 2 and 3 portray some of the achievements of the assistance program that could only be designed after the inventory.

Table 2. Irrigable area and cost of improvements to 19 farmer-managed systems

System Name	Existing Command Area (Ha)	Command Area Expansion (Ha)	Total Irrigable Area (Ha)	Project Grant (NRs.)	Cost per Irrigable Area (NRs/ha)
Chhahare Khola	126	37	163	126,615	777
Soti Bagar	19	11	30	150,699	5,023
Dovaneswar	2	10	12	74,807	6,234
Magar	100	43	143	160,805	1,125
Siran, Tar	18	6	24	136,789	5,700
Majh, Tar	71	16	87	114,321	1,314
Ghatta Muhan	23	10	33	124,321	3,767
Jhankri	18	13	31	91,707	2,958
Chholang	23	14	37	116,066	3,137
Siran, Baguwa	18	19	37	57,488	1,554
Majh, Baguwa	13	20	33	113,541	3,441
Chapleti	8	15	23	78,065	3,394
Baghmara	3	6	9	44,433	4,937
Chap Bot	12	5	17	71,630	4,214
Bhanjyang	21	14	35	65,178	1,862
Dhap & Subedar	30	35	65	85,000	1,308
Naya Dhara	55	55	110	139,720	1,270
Besi	65	20	85	119,839	1,410
Total	625	349	974	1,871,024	

(*Source: WECS/ IIMI, 1990*)

Average cost per irrigable hectare	NRs. 1921
Average cost of supervision tools and farmer training per irrigable ha.	NRs. 1365
Total cost of improvement per irrigable hectare	NRs. 3286
	========

**The cost in Nepali Rupees (NRs) is based on 1985 exchange rate: 1 US$ = NRs. 22.

Table 3. Savings in cost of improvements due to farmer participation
(Prices are based on 1985 exchange rate of US$ 1 = NRs. 22)

System Name	(a)	(b)	(c)	(d)	(e)	(f)
	First Priority Work					
	Grant (NRs. '000)	Actual Expenditure (NRs. '000)	Saving (a-b)a (%)	Farmers Contribution (NRs. '000)	Work Completed (NRs. '000)	Effective Increase (%)
Chhahare Khola	127	62	51	3	168	132
Soti Bagar	151	83	45	1	167	111
Dovaneswar	75	68	9	1	89	119
Magar	161	133	17	1	192	119
Siran, Tar	137	40	71	1	214	156
Majh, Tar	114	96	16	1	143	125
Ghatta Muhan	124	82	34	0	170	137
Jhankri	92	28	70	1	108	117
Chholang	116	41	65	1	136	117
Siran, Baguwa	57	42	26	25	81	142
Majh, Baguwa	114	85	25	42	170	149
Chapleti	78	60	5	19	109	140
Baghmara	44	30	32	12	73	166
Chap Bot	72	60	17	16	86	119
Bhanjyang	65	50	23	15	102	157
Dhap & Subedar	85	35	59	4	154	181
Naya Dhara	140	105	25	21	245	175
Besi	120	95	21	10	221	184
TOTAL	1872	1195	36	174	2628	140

(*Source:* WECS/ IIMI, 1990)

(a) Grant amount allocated to the systems to complete most first priority work as estimated using national norms.

(b) Grant money expenditure for completing first priority work. Money saved, (a-b) was used for second and third priority work.

(c) Savings in comparison to the grant allocated.

(d) Unpaid labor (calculated as the number of person-days of labor multiplied by the district wage rate) plus the difference between the district rate and a lower labor rate as agreed to by farmers in some systems to reduce cost.

(e) Value of work completed as computed using national norms. This is higher than (a+d) because: 1) estimates computed by norms are generally high, and 2) work efficiency due to farmer participation was very high.

(f) Effectiveness of farmer participation in accomplishing more than estimated by the national norms.

The ultimate objective of this inventory study was to provide information necessary for the selection of the systems where further study and possibly development activities were warranted. Based on the experience of the action-research project, the most important information to be included in the inventory study was the information about the potential for expanding or intensifying irrigation from each particular system. The essential characteristics to examine are:-

The Land Resource: Is there land in the command area that is not irrigated or irrigated in only part of the year or is there area that can be extended if the system is improved?

The Water Resource: Is the water discharge in the source sufficient for expanding irrigation or are there other sources that could be tapped?

The Water Rights: Are there several systems competing for the water in the source? Is there possibility of tapping more water?

The Water Allocation: How are the rights to use water within a system allocated and are the present beneficiaries or owners of the system open to adding new members?

The Physical System: What are the major difficulties faced in acquiring and delivering water in the present system?

The Management System: How well are the present beneficiaries or owners of the system organized to operate and maintain the system?

The Agricultural System: Information on cropping pattern in the head and tail of the irrigation area, frequency of irrigation, inputs other than the irrigation, support services such as JTA, loans. Are crops mainly marketed or consumed by farmers?

DESCRIPTION OF DHADING DISTRICT INVENTORY

The Dhading Development Project (a district development project) funded by GTZ felt the need for a comprehensive inventory of the existing and potential water uses by the people of Dhading. This water resource utilization inventory was undertaken with the hope that the study would generate information that will assist central as well as the district level agencies to effectively plan and implement small scale water resource development. A Nepali consulting firm was commissioned to undertake the inventory study. The inventory included i) the existing and proposed forms of water resources and their utilization for existing and proposed irrigation systems as well as hydro-power units, ii) a quantitative assessment of available water resources for irrigation, and iii) identification of the potential for future development of available water resources for irrigation (Silt Consults, 1991).

The study concentrated on inventorying all rivers and streams from which irrigation systems and hydropower have been developed. The study also undertook an inventory of all water sources from which future irrigation systems or hydropower could be developed. Even irrigation systems with command areas less than .25 ha were included in the inventory.

The activities for the inventory were carried out in four stages. Both secondary and primary data were collected. The first stage involved the collection and analysis of secondary data and the preparation of a report based on it. The second stage included field work and reporting it. The third stage consisted of the comparative study of the report based on secondary materials and the report based on actual field work. The final stage was the preparation of the final report.

The following section describes various activities undertaken during the four stages and lessons learned during those stages. The first phase concentrated on maps and photographs (e.g., topographical maps, land utilization maps, cadastral survey maps, village maps, aerial photographs, etc.) and data pertaining to i) village profiles, ii) hydrological data on rivers and streams, iii) information on agency managed or financed systems, iv) information on locally developed irrigation, v) information on irrigation projects approved by the local district development administration, vi) land survey registration data, vii) land utilization and land capability data, and viii) information on all hydro power units located in the study area.

The abovementioned information were collected and analyzed for specific purposes. The village profiles helped ascertain the present status of the uses of existing water sources within each village administration. The irrigation department's various reports helped in the preparation of the salient features of the projects within the study area. The various cadastral, land use and capability maps helped in presenting the overall agricultural situation of the study area and also identify where irrigation systems may be located. Topographical maps and aerial photos were helpful in supplementing information from other sources and in the preparation of the base map for the inventory study. This new base map was prepared for the purposes of the inventory to indicate in the map itself the location of the various water uses.

The final report of the inventory work (Silt, 1991) however note that clearly the only direct basis for the inventory would be the actual field survey. It was necessary for the field team to actually visit each irrigation system and conduct "walk-throughs" to identify the details of existing water use. The report recognizes that "for potential water use systems local people and their political representatives needed to be contacted and interviewed before such systems could be built or expanded to increase their capacity.

During the second stage, the field survey was prepared, field work undertaken and the data analyzed for the preparation of the final report. The field team typically consisted of an engineer, an overseer and a number of assistants. They had with them aerial photos, topographical and various other maps and equipment like magnifying glass, abney levels, altimeters, measuring tapes, etc. During the team's field visit, the various members met with local villagers, walked through the irrigation systems and observed water use. The inventory study team prepared a data compilation form which was filled at the site (See Annex 1 as a sample). The form included the various indicators thought to be important for assessing existing and potential irrigation schemes.

Field teams had continuing discussions and orientation meetings among themselves and with the Dhading Development Project advisors. Even in the field itself, the teams discussed the inventory work and issues involved. The field work was discussed and the data gathering process improved through successive meetings and discussions.

A typical field visit consisted of the following steps.

1) Upon arrival, the team, with the help of the local people and authorities, verified the list of all water use schemes currently in use and those proposed;
2) Those schemes not entered or missed for the village area were noted;

3) The data compilation form for existing and new potential water use schemes was completed during interviews with the users and local authorities; and

4) Information provided during interviews was verified by actual measurement and assessment. Data verification and assessment was carried out by the team by actual observations of the hydro-units and walk throughs of the irrigation systems. This information included in the reference maps. The final compilation of information was again discussed with farmers and local people for further verification and cross-checking.

The various lessons learned and problems encountered during the field work stage are as follows.

1) The precise village administrative boundaries were either drawn wrong in the maps or were unknown to the local inhabitants and therefore it was difficult to carry out the inventory on the basis of the village administrative boundaries;

2) The cadastral and village maps seldom indicate all the irrigation systems within the village;

3) At times it was difficult to communicate with the local inhabitants because the field team did not understand the local language;

4) Several villages were very indifferent and negative towards the field inventory because they had experienced several teams undertaking surveys there but without any results or benefits for the village;

5) Where several field teams were mobilized, it was difficult to bring about a uniform approach;

6) Farmers were generally more enthusiastic about receiving grants than loans and were willing to contribute labor to developing the irrigation systems; and

7) The time taken for the inventory differed from one village to another. However, on the average, it took around 15 days for one village which had multiple irrigation systems.

The last two stages were devoted to writing the report incorporating the suggestions and comments made by DDP on the field findings. Information and data were analyzed and improved upon after successive meetings and discussions not only with the DDP advisors but also among the various field teams.

The specific indicators or information sought are outlined in the data compilation form (See Annex I).

CONCLUSIONS OF THE DHADING DISTRICT WATER USE INVENTORY

1. Interaction between the inventory team and DDP advisors was crucial for the refinement of the inventory approach. As the study was undertaken, the scope of work, data collection methods, and recording was constantly improved upon. Given this scenario, the flexibility provided by DDP to the inventory team was important for carrying out the new targets.

2. The inventory was able to list 1766 streams and 71 springs in Dhading district with an area of 1926 sg. km. The various water use units such as irrigation systems, traditional water mills (ghattas), water mills and mini hydro-electricity generation units have been inventoried. It was found out that there were 2961 existing irrigation systems, 359 traditional water mills, 69 water mills, and 9 improved water mills. Similarly, in the case of irrigation systems, the inventory identified 163 potential irrigation schemes which could be developed tapping 110 streams and one spring (Silt, 1991).

3. The inventory did include some non-technical information regarding the organization of the irrigation systems but more variables regarding the socio-institutional aspects of irrigation management could have been incorporated.

4. There was a lack of meteorological data for the district because there were only two hydro-meteorological stations in the whole district.

5. Though the district is rich in water resources, much of it cannot be used because the river beds are far below the potential arable land.

6. In terms of the distribution of the irrigation systems, it was found that systems less than 20 ha numbered 2891 with a total area of 8213.1 ha while those above 20 ha numbered only 70 systems covering 3626.25 ha.

7. For purposes of planning, the inventory proved to be useful because out of the 71 irrigation schemes proposed for survey by the district development administration, 68 were found by the inventory to have potential for further improvement. Thus, these systems deserve further investigation before investments are made on them.

8. In terms of irrigation technology, the report notes that the inventory did not take into account the possibility of small scale irrigation with pipes. The farmers living higher up in the mountains with upland fields could benefit through pipe irrigation on their orchards and vegetables.

CONCLUSIONS

Several agencies involved in the development of irrigation in Nepal have not only used the information from the IIMI/WECS inventories but also have started to adopt the methodology used in IIMI's preliminary strategic action-research with WECS for improvement of FMIS. Examples of projects that made use of information generated by the WECS inventories include, the Irrigation Master Plan Study, the Irrigation Sector Project, and the Mechi Hill Irrigation and Related Development Program. The Mechi Hill Irrigation and Related Development Program implemented under the assistance of the Netherlands Development Organization (SNV-Nepal) is spread over three districts- Taplejung, Panchthar and Ilam in the eastern border of the country in Mechi Zone. The master plan for irrigation development in Nepal prepared under financial support of UNDP/World Bank has extensively used the information from the reports of the district inventory. The Irrigation Sector Project under the Department of Irrigation has been using information from the district inventory reports for selecting irrigation systems and areas for irrigation development.

The nature of work of the Mechi Hill Program in the development of irrigation is similar to that of Action-Research Project implemented by WECS in Sindhupalchok District. The objective of this project is to rehabilitate, upgrade and construct approximately 50 farmer irrigation systems with participation from farmers and the District Irrigation Office. For this purpose, the program had to select systems having potential for improvement and expansion, for which the program used the district inventory reports prepared by WECS as basic documents, in addition to the information gathered by the program during survey and discussions with local people. For collection of in-depth information and selection of priority schemes, the program also used the methodology adopted in action-research in Sindhupalchok District. This procedure helped the program to select specific systems for improvement. The experience of the WECS action-research was utilized during implementation of the improvement works as well.

The three inventories discussed above showed the importance of both the use of secondary materials and the field inventory. The rationale of inventories also varied in that i) they were meant to provide basic information regarding the status and condition of *"what is out there"*, ii) use such information for planning water use within a watershed, basin or district, and iii) provide information in order to rationalize and prioritize assistance and support services to irrigation systems.

The type of information collected for each system differed between the inventories depending on the magnitude and scope of the inventory. Who to contact for such information also becomes crucial for successful results. Though physical and agricultural indicators are important, the socio-institutional variables are also equally important to be included in the types of information sought from each individual system. Such information are very useful for planning water use within a river basin as well as selecting systems for assistance.

The abovementioned information could have been collected from individual systems by including questions related to methods of water allocation, methods of resource mobilization, membership criteria and expansion, levels of organization and functionaries, types of records kept, types and frequency of meetings, rules and roles of the organizations, conflicts and their resolutions, sanctions, ethnic group distribution within the system and ownership of the system. The history of system creation and expansion, the interrelationships with other irrigation systems in terms of water sharing or resource mobilization, method of water allocation for the interconnected irrigation systems and water rights are some of the types of information necessary to be included in an FMIS inventory - if the objective is to select systems to assist on a priority basis or plan and manage the various uses of water along a river basin.

The various inventories in Nepal and elsewhere (for example, Lintau Buo Inventory conducted by Ambler (1989) in West Sumatra) show that the inventory is an iterative activity. It must undergo several revisions and verifications. Even then, *"an inventory is a rough overview and is not intended to provide detailed data on each irrigation system. For personnel in the field, it provides a basis for subsequent revisions. For planners at higher levels, it is intended to start to fill a gap where little or no data on macro, intersystem relationships previously existed (Ambler, 1989)"*. Nepal's experience in inventories (and their objectives) does have relevance in Southeast Asia and vice versa regarding the methodological and substantive issues of inventories. Ambler's (1989) experience in inventorying in West Sumatra dealt with similar issues that the Nepal inventory teams faced.

Usually inventories are "externally" driven, meaning that the types of information collected for specific objectives like planning water use within a watershed or being able to select systems on a priority basis are thought of in advance by the inventory team. An effective process for involving farmers in data collection tasks or letting irrigators themselves determine types of data and information to collect is still in need of development. A move towards a more participatory inventory needs to be developed rather than only involving farmers in "verification" of the data and information. Locally-originated inventories of irrigation systems and development potential sometimes occurs informally among villagers using indigenous knowledge and historical experience. Having agencies (government or non-government) facilitate development of farmer-developed inventories (to improve water rights and allocation systems, support services and marketing) is a strategy worthy of experimentation in the future - in order to meet information needs of farmers and to make support services more demand driven.

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Annex 1. Data Compilation Form (i) (Existing System)

1. System Number: T2-00-00-00/4(9)/32
2. Name of System: Mill Kulo
3. Ward No(s): 9
4. Name of v. Panchayat: Thakre
5. Persons Interviewed: Siddi Raj Pandey
6. Area served and accessibility: On the Prithivi Highway
7. Type of system: 1
   1. Existing farmer group 2. Gov't. managed
   3. Gov't. Planned construction 4. Individual of family managed
8. Name of basin/sub basins: Mahesh Khola
9. Type of source: 2
   1. Seasonal 2. Perennial 3. Part seasonal
10. Nature of source: branch stream B. of Trisuli
    1. Spring 2. Spring fed gully 3. Small stream 4. Main stream
    Branch stream of:
11. Hydrological data of source at point of abstraction
    Max: 117334 LPS Min:310 LPS Flow measured at (on): 758/07.03.46 LPS
12. Point of Abstraction (with local place name, ward No. etc).
    Dharke, 9/Thakre
13. Length and capacity of canal: 1100/30 Meters and LPS respectively.
14. Type of canal with main features:
    Simple unlined canal
15. Type of head work or diversion structure:
    Dry stone masonry
16. Land area served: 100 Ropani
17. What are the main irrigated cropped areas, crops and cropping season?

1. Summer	Rice/Maize	0
2. Winter	Wheat	0
3. Other		0

18. When was system built and who first built it: Traditional
19. Any external assistance utilized for building/improving, when and how much? No
20. Number of households having land in command area: 16 HH
    Smallest holding: 1 Ropani Largest Holding: 15 Ropani
21. a) When/how often is the system repaired and maintained:
    Every year by farmer
22. Can the system be enlarged/extended to increase capacity and how? Yes
23. What is the farmers need? Irrigation or other inputs:
    To construct a permanent intake structure
24. Comment on farmer's enthusiasm and willingness to raise local resources and utilize grant/loan received to increase/enlarge capacity: Y
25. What are the limitation? 3 1) Water source 2) Money 3) Land
26. Is there enough area (Yes/No)?: N
27. Is there enough water (if not, in which month)?: Yes
28. Who are the key persons/farmers of the system names and address:
    Kedar Pd. Pandit Organization structure: Informal
29. Effectiveness of organization (effective, ineffective): E
30. Consultant's comments and suggestion and recommendation as to whether the system has potential for further investigation and by whom
    (Recommended, not recommended): R by ADBN
31. Any other remarks/information: It serves a water mill of Mr. Kedar Pd. Pandit. He wants to enlarge its capacity by construction of a permanent side intake and increase the power of the mill and more area will be irrigated.

Source: Silt Consultants (P.) Ltd. 1990.

Status of Farmer Managed Irrigation Systems in Bangladesh

M. A. Ghani and S. A. Rana[22]

INTRODUCTION

About 30% of cultivated land has access to some forms of irrigation in Bangladesh. According to the government projections 90% of the irrigated area would be covered entirely under farmer managed irrigation systems by the end of the fourth five year plan, 1994-95. Minor irrigation systems cover and would continue to cover about 90% of the country's irrigated area mostly managed by farmers. In the near future, even large scale gravity irrigation systems would be partially managed by farmers. On-farm distribution and management of irrigation water would be done by the farmers and public agency intervention would be in planning, implementation and operation and maintenance of the main system. However, farmers would have to bear at least part of the operation and maintenance cost. To make farmer participation effective their involvement should be ensured from the conceptual stage of a project to its operation. Water charges could be collected from farmerss in an amount at least to cover annual O&M costs. Farmers should be organized to take over operation and maintenance of the completed projects. For larger flood control, drainage and irrigation (FCDI) projects and those requiring higher levels of skill, government institutions should provide technical and logistic supports.

Presently, pure farmer managed and farmer cum government managed irrigation systems are in operation in Bangladesh. However, under the present management system, irrigation facilities are operating at about half their potential capacities. In this paper, aan attempt is made to inventory farmer managed irrigation systems and their management status. Experiences of some case studies are used in suggesting improvement alternatives.

Water availability during the year in Bangladesh is highly skewed since the country is subject to alternating annual periods of extreme excesses and deficits in rainfall, recurring floods and cyclonic storms (Ghani and Rana, 1992). Both surface and groundwater are used as a source of irrigation in Bangladesh. But the country does not have much control over surface water since most of the flow comes during June to September from catchment areas outside Bangladesh. Most of the streams remain dry or nearly dry during November to May and cannot be used as a dependable source of irrigation unless conservation and augmentation facilities are created. A more dependable source of irrigation is groundwater extraction.

In the past, development of both surface and deep tubewell groundwater resources for irrigation has been entirely done by government agencies. Recently, most of groundwater irrigation systems like Deep Tubewells (DTWs), Shallow Tubewells (STWs) and other Manually Operated Pumps for Irrigation (MOSTIs) have been privatized. Low Lift Pumps (LLPs) which pump surface water are also operated and managed by farmers. Installation, operation and

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maintenance of the large surface irrigation systems are carried out by government agencies. Presently, irrigation systems are managed by either farmers or farmer-cum-agencies. However, it is expected that by the end of the Fourth Five Year Plan (1994-95) of Bangladesh, about 90% of the irrigated area would be covered by farmer managed irrigation system (Table 1).

Table 1. Irrigation Achievements and Target of Irrigation Coverage Under Different Systems in Bangladesh

PROGRAM 1/	1989-90 Achievement		1994-95 Target	
	Number ('000)	Area ('000 Ha)	Number ('000)	Area ('000 Ha)
Gravity	-	210.00 (7)	-	500.00 (10)
LLP	60.00	780.00 (25)	75.00	1090.00 (23)
Trad	-	300.00 (10)	-	200.00 (4)
DTW	30.00	500.00 (16)	35.00	700.00 15)
STW	200.00	1250.00 (40)	500.00	2250.00 (47)
HTW	450.00	50.00 (2)	450.00	50.00 (1)
TOTAL		3090.00		4790.00

Adapted from the Fourth Five Year Plan (draft)

Figures in the parenthesis indicate percent of total irrigated area.

1/ LLP Low Lift Pump
Trad Traditional
DTW Deep Tubewell
STW Shallow Tubewell
HTW Hand Tubewell

MANAGEMENT STATUS

Irrigation systems in Bangladesh are generally managed by agencies, farmers or by both sharing responsibilities. Within each category of managements there are different arrangements. Different management systems are briefly described as:

Gravity Irrigation

Most gravity irrigation systems are identified, planned, implemented, operated and maintained by government agencies. Bangladesh Water Development Board (BWDB) is the lead agency in the field of surface water development. BWDB delivers water up to the tertiary head gates and assumes that farmers should take responsibility of on-farm development and water distribution at the tertiary and farm levels. There is a large gap between expectations of BWDB and actions by farmers. Therefore, BWDB-managed irrigation systems have not achieved more than 50% of irrigation targets in most of the irrigation systems. Recently, BWDB is actively considering involvement of its farmers in project identification, project preparation, implementation, and operation and maintenance stages in order to achieve long term sustainability of water development programs. The water development program of BWDB involves Flood Control, Drainage and Irrigation (FCDI). In addition to these, BWDB also deals with river bank protection and river training. BWDB has implemented 465 projects in Bangladesh which cover 0.43 million hectare under irrigation. This is only 6% of the total FCDI area in the country (BWDB 1991). In BWDB irrigation projects, farmers are required to pay a very small irrigation fee for dry and wet seasons. The irrigation fee collection rate is only about 10%.

Minor Irrigation

Minor irrigation in Bangladesh includes irrigation using low-lift pumps, deep and shallow tubewells, hand tubewells and doon and swing baskets (MPO 1991). This type of irrigation has been the driving force behind agriculture in the past and is expected to stay so in the near future. Therefore, management is very important for capacity utilization of minor irrigation systems. Management types and their impact on agricultural development are discussed in the sections below.

Deep Tubewells. Deep Tubewells (DTWs) in the pasthave been installed, operated and maintained by government agencies. Farmers were utilizing the facilities for increasing production. DTWs during early days were almost free for the farmers since they were only paying a nominal annual rent and fuel-oil. Additional production was a main policy goal for the country. Annual rent was increased several times and finally the government decided to sell all deep tubewells to the farmers at a subsidized rate. Many farmers have been reluctant to buy the tubewells though these are highly subsidized. However, with continued persuasion by donors and government agencies, a large number of deep tubewells were sold to the farmers or groups of farmers. However, many are still owned by the government. Therefore, a mixture of deep tubewell management systems exists in the country. In Bangladesh until the recent past all deep tubewells were government supplied. Ownership patterns changed only due to the policy decisions mentioned above. Therefore, present deep tubewell irrigation systems are of the following types:

i) Agency ownership (rented to the farmers) and privately managed;
ii) Agency supplied but private ownership and management;
iii) Agency supplied, NGO ownership and private management; and
iv) Private supply, ownership and management

Within these management systems there are various types of rents (farmers pay rent plus fuel-oil, pay only rent and everything is beared by the agency etc.) and management modes (managed by a farmer and others pay rent per unit of service area in cash or crop share, managed by group of farmers and they share operation and maintenance cost). Mode of payment for some of the management alternatives are: 25% crop share cash (managers' fuel), cash (farmers' fuel), 33% crop share (Mandal and Miah 1992).

Shallow Tubewells. Shallow Tubewells (STWs) during the early seventies were supplied to the farmers by government agencies on credit. It was the responsibility of farmers to operate and maintain them. During 1973-74, shallow tubewells were supplied, installed, operated and maintained by the Bangladesh Agricultural Development Corporation (BADC) and were rented to the farmers. Later on cash sale, sale on bank credit or sale by private parties were allowed. The private sector rapidly captured the market and subsidies provided by the agencies were withdrawn. Currently, private and public sectors are competing and most of the shallow tubewells are installed through private sector initiatives. A shallow tubewell is generally owned by a farmer or a family for irrigating primarily their own farm and sells or supplies water to the adjacent farmers after meeting their own demand. Therefore, the management mode for shallow tubewells is private management from the beginning. Irrigation fees or water charges are either in cash per unit of service area or crop share at mutually decided rates.

Low Lift Pumps. Irrigation in this part of the world started with power pumps in the mid-fifties. The government agency used to supply free pumping units, operators and fuel-oil during the early days. Then rental systems for the pumps and operators were introduced and farmers had to provide fuel and oil for operating the pumps. Farmers shared the seasonal operating cost. From the mid eighties, the government decided to sell all Low Lift Pumps (LLPs) to the farmers or group of farmers. Therefore, presently all LLPs are owned by individual farmers or group of farmers. Management of LLPs is done by farmers depending on ownership (individual farmers or groups of farmers - either formal or informal). Irrigation fee collection is again in cash per unit of service area or crop share mutually decided by the LLP owner and users.

In certain areas of the country, LLPs are used where irrigation inlets or pump stations were developed by government but operation and maintenance of the irrigation system and water distribution are managed by groups of farmers. Such systems are reportedly performing well. Some examples are the following.

> *Gohalbari Small Scale Irrigation Project.* This LLP small irrigation scheme was developed during 1978-79 with the help of BADC in the Nawabganj area. Three pumps, each with 56 litres/sec (1/s) capacity are pumping water from the river Mohananda. Operation, maintenance and water distribution are managed through a 12-member management committee. The society has 300 members who share water. The service area is about 60 hectares (ha). The water distribution system has a 100 meter lined canal and 240 meter unlined canal. The managing committee collects an irrigation fee of Taka 2600ha (US$ 65ha) for dry season rice and Tk. 1300/ha (US$ 33/ha) for wet season rice and wheat cultivation. Staff manage water distribution in the service area. Farmers pay Tk. 225/ha (US$ 6/ha) for the water distributors. From the irrigation fee, the managing committee operates and maintains the irrigation system and saves for future emergency maintenance and replacement of pumps.

Palsa Low Lift Pump Scheme. This was a BWDB-managed irrigation scheme in Nawabganj where BWDB used to operate and maintain the system and farmers were to pay irrigation fee per unit of service area. The scheme has four pumps and a service area of 26 ha. Farmers were not satisfied with service from BWDB and irrigation fee collection was poor. Pumps (4 units) were sold to the farmer group in 1989. At present it is purely farmer managed, managed by five member management committee. Farmers are paying Tk. 3700/ha (US$ 93/ha) for dry season rice crop which covers operation and maintenance cost and saving for emergency maintenance. For other seasons, farmers share the fuel and oil cost only. In addition to the fixed irrigation cost, farmers pay Tk. 270 (US$ 7/ha) for a water management staff who takes care of water distribution in the service area. Farmers are happy with the present system though they are paying a much higher irrigation fee as compared to BWDB irrigation rate. Moreover, with a feeling of being owners they feel more responsibility for the system.

Buri River (2 vent inlet) Irrigation System. This small scheme is located in Companiganj, Comilla. This is part of a flood control and drainage (FCD) project operated by BWDB. Farmers requested BWDB for an irrigation inlet which was completed in 1991. Farmers were growing only one non-irrigated rice crop in that area prior to flood protection facilities being developed by BWDB. A farmer organization was formed which manages a 56 1/s low lift pump which pumps water from the irrigation inlet. A 30 ha. area is irrigated and three crops are grown annually in the area. Eighty farmers are getting benefits from the system. The organization collects an irrigation fee of Tk. 3000/ha (US$ 75/ha) for dry season rice in three installments. On an average, farmers get about 11.0 t/ha of paddy from two rice crops, in addition to a non-rice crop annually.

The above case studies indicate that farmer managed irrigation systems are operating effectively. However, these systems were initiated by the government agency and were handed over to the farmers for operation, maintenance and management.

Other Pumps. Hand tubewells and other manually operated pumps such as twin treadle are used for irrigating mostly vegetables, tobacco and other non-rice cash crops. Local skilled laborers are used for installing these pumps. Banks and other non-Government Organizations (NGOs) are providing credit and other support services in promoting these simple irrigation equipment. Operation, maintenance and water distribution are managed by the farmers and mostly by family laborers. This simple and less expensive technology is gaining popularity.

INVENTORY OF MANAGEMENT STATUS

Most of the farmer managed irrigation systems are presently developed with minimal support from the government agencies. But by the end of the Fourth Five Year Plan (1994-95) all the minor irrigation systems which will cover 90% of the country's irrigation would be privatized and will be purely managed by the farmers. Farmers in such cases will have to collect irrigation equipment from the sources of their choice and government agencies like BWDB and BADC will not have much of a role in the distribution of irrigation equipment. NGOs and private sector will play a major role in the distribution of irrigation equipment. However, Bangladesh Rural Development Board (BRDB) and the Directorate of Agricultural Extension (DAE), as extension organizations, will continue to work closely with farmers and farmer organizations. Therefore, inventories of irrigation scheme management and technology needs could be pursued through these agencies. After full privatization has occurred farmers will be in need of new support services for technology acquisition and replacement, agricultural inputs and marketing, and management and conflict resolution support. Management inventories would fill a useful role in ensuring formation of a client-responsive support system in the future. Institutes involved in irrigation research could be lined up to help in this area. Interested professionals could develop questionnaires and work through DAE and BRDB in updating irrigation management status.

CONCLUSION

The majority of irrigation systems in Bangladesh are managed by farmers. Public sector investments through government agencies were involved in infrastructural development but these are declining and will be completely withdrawn in the near future. However, government would continue to support relatively large gravity irrigation systems and FCD projects and beneficiaries will progressively bear the full O&M cost. The farming community should be educated to participate in the FCD/FCDI systems to ensure sustainability. Farmers management modes should be reviewed, monitored and updated through extension and research organizations for further improvement.

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Intervention in Farmer-Managed Irrigation in Northeast Portugal: Results of an Inventory Study

Jose Portela and Adrian van den Dries[23]

INTRODUCTION

Tras-os-Montes, a region in Northeast Portugal, has extensive farmer-managed irrigation. The systems which were constructed over the centuries, are managed, maintained and improved by farmers. This paper presents the methodology and results of the first phase of an on-going inventory study. The final objective of the inventory research is to develop a typology of FMIS with the aim to assess the adequacy of intervention strategies. The research focussed on all aspects of irrigation water management. The Uphoff-matrix of irrigation system activities was used as a basis to gather and systematize data on management of FMIS. The research utilized some rapid appraisal methods. During a period of three months, 24 villages in two agro-ecological zones were visited. Besides an inventory of water sources at the village level, data collection focussed on the management of the most important communal systems. Common features as well as diversity in the functioning of communal FMIS had been identified.

Water allocation principles, water availability and water distribution practices are considered determinant elements in explaining the enormous diversity among communal systems and their environments. Mountain areas and high elevation valleys show significant differences in these elements. They can be considered as building blocks for the construction of a typology for intervention purposes. Interventions by groups of water users nearly always bring about changes in these elements. Empirical evidence shows that water users also actively invest in individual irrigation facilities, principally in the high valleys. Currently, a government programme aimed at the improvement of FMIS is being carried out. The diverse reasons, forms and features of intervention by water users as well as the government have been identified. It is concluded that institutional interventions could be improved by taking into account three strategic elements:

- Developing an integrated approach to local irrigation development;

- Linking up this approach with actual interventions implemented by water users and local organizations; and

- Combining the implementation capacity and decision making of local water users and organizations with critical resources made available by state agencies and other institutions in an indirect investment approach.

23 Jose Portela is a Professor of Rural Sociology at the Universidade de Tras-os-Montes e Alto Douro. Adrian van den Dries is an Irrigation Engineer from Wageningen Agricultural University, the Netherlands. Both are working on the research project, "Intervention Strategies in Traditional FMIS in Northern Portugal".

Traditional Farmer-Managed Irrigation Systems (FMIS)[24] serve an area of 550,000 ha or 83% of the total irrigated area in continental Portugal (DGRAH, 1987). The importance of farmer-managed irrigation is underscored by its use on small to very small family farms (<10 ha) in the country as a whole and in the northern and central parts in particular.

In the region of Tras-os-Montes (TM), Northeast Portugal, more than 1000 FMIS were identified, serving an estimated area of about 30,000 ha. The schemes are small, being concentrated in two agro-ecological zones: the Mountains and the High Valleys which form the Research Area (Figure 1). Small and very small family farms whose areas are divided in numerous plots constitute the prevailing production units.

The Tras-os-Montes Integrated Rural Development Project (PDRITM), launched by the Government in 1982 has defined the improvement of FMIS as a basic condition for agricultural development in TM. Effectively 116 FMIS had been improved till March 1990 (Portela, 1990). A second phase of this programme is being contemplated over a period of seven years.

The intervention program of FMIS in TM executed by PDRITM, has been set up without detailed knowledge about the complex functioning of traditional irrigation schemes prior to improvement. The research project "Intervention strategies in Traditional Farmer-Managed Irrigation Systems in Northern Portugal"[25] is aimed at getting a more clear insight into the functioning of existing FMIS prior to improvement, the actual intervention process as implemented by PDRITM and the effects which are generated by the interventions. As a component of the research project an inventory study of FMIS is being carried out.

The final objective of the inventory research is to develop a typology of FMIS which can serve as a tool for adequate interventions and to identify relevant elements for designing improved intervention strategies. The paper presents the methodology and the results of the first phase of this inventory research supplemented by post hoc observations and empirical material of case studies. The context wherein FMIS operate is the subject of the next section.

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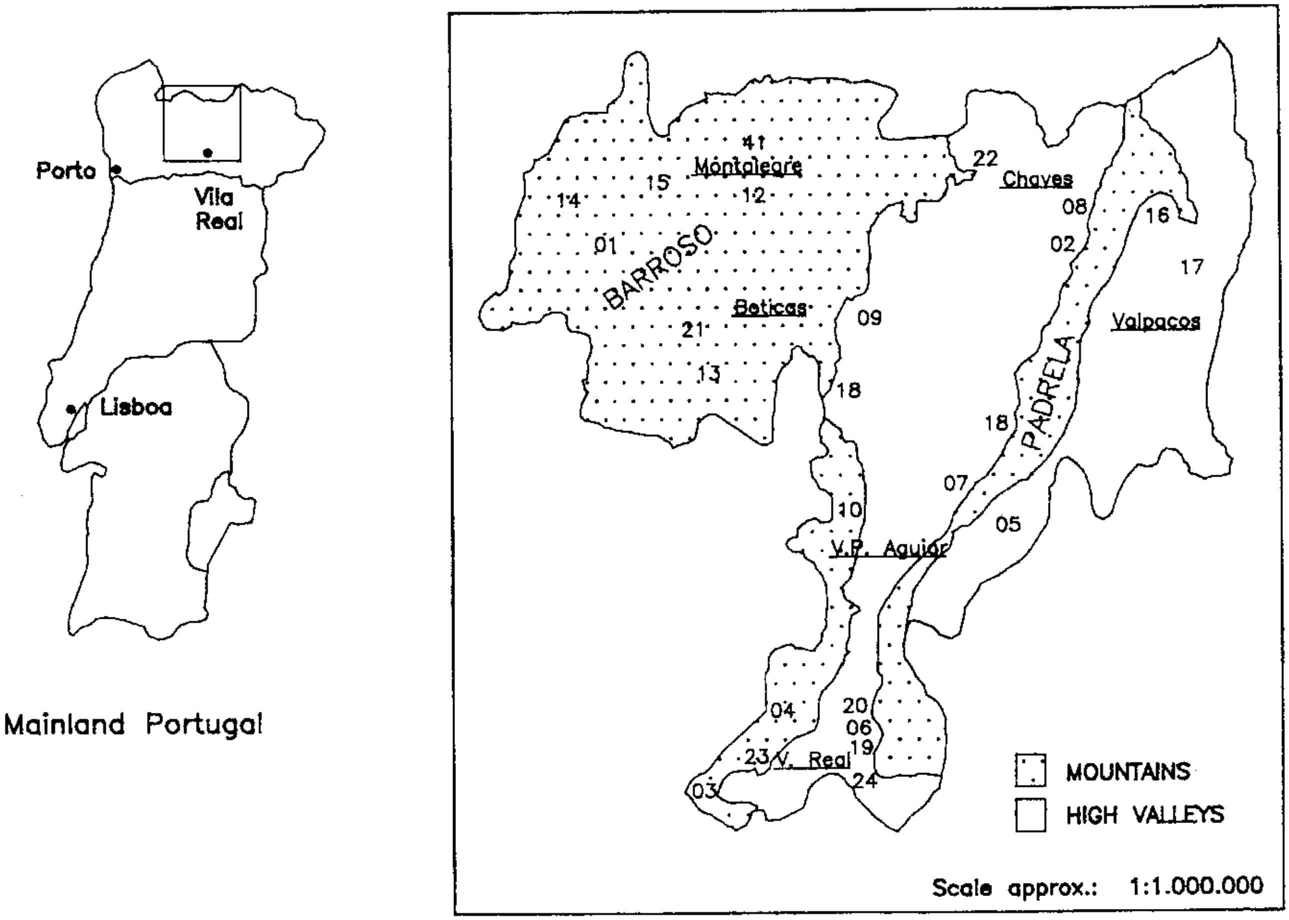
24 The term "Farmer-Managed Irrigation System (FMIS)" will be used for all those schemes which are constructed, maintained and managed by farmers, both collectively or individually. The qualification "traditional" indicates that these schemes generally have a long history. Until recent times, State intervention in "traditional" FMIS has been none or minimal.

25 The paper is a result of this research project. Its execution is a joint venture with the Department of Economics and Sociology (DES) of the University of Tras-os-Montes e Alto Douro (UTAD) in Vila Real, Portugal and the Department of Irrigation and Water Conservation of the Wageningen Agricultural University (WAU) in the Netherlands.

Figure 1. Research area with selected villages



SELECTED VILLAGES

01 CORVA
02 SESMIL
03 VILA COVA
04 LAMAS D'OLO
05 COVAS
06 BOUCA
07 SEIXEDO
08 TRESMUNDES
09 SOBRADELA
10 ST. MARTA DO ALVAO
11 MEIXEDO
12 TORGUEDA
13 ROMAINHO
14 PINCAES
15 FERVIDELAS
16 ADAES
17 SANTIAGO
18 VILELA
19 ST. MARTA
20 ABOBOLEIRA
21 BOSTOFRIO
22 SOUTELO
23 GALEGOS DE SERRA
24 VILALVA

THE RESEARCH AREA

Some relevant differences between mountainous areas and high valleys are shown in Table 1.

Table 1. Differences between mountains and high valleys

Characteristics	Mountains	High Valleys
a) Elevation	800 - 1200 m	400 - 800 m
b) Annual rainfall	700 - 1500 m	500 - 1500 m
c) Irrigated/total cultivated area	56% (Barroso) 40% (Alvao/Padrela)	21%
d) Farm size	77% of farms smaller than 5 ha.	81% of farms smaller than 5 ha.
e) Crop production	Rye/(seed) potatoes rotation. Permanent meadows (lameiros) and forage crops. Communal lands ("baldios") used for grazing and forest. Cattle raising oriented to produce meat.	Rye/potatoes rotation. Forage crops and some "lameiros." Vineyards and olive trees. "Baldios" less important for grazing. Cattle raising oriented for produce milk.

Besides the specific physical and local environment, FMIS operate in a broader socio-economic context from which we want to highlight the following points:

1) TM is commonly presented as the most depressed area of Portugal. It has an underdeveloped social and economic infrastructure (education and health facilities, roads, markets etc.).

2) The limited employment opportunities in TM outside agriculture. In 1982, still more than 70% of the labor force was engaged in agriculture (WB, 1982).

3) These factors have contributed decisively to the massive emigration from the rural zones since the late 50's. According to preliminary data of the 1989 census, in the last ten years, the population of TM diminished by more than 50,000 persons, which is more than 10% of the total population. In some rural zones, decreases of up to 30% have taken place in the same period. This massive emigration has profound influence on the management of farms and irrigation systems (See section 6).

The role and importance of irrigation in farming cannot be separated from overall household objectives and strategies. Some general features are:

- Making the best use of the fragmented plots and diverse land qualities and microclimates within the same farm. This explains in part the polycultural character of farms and the integration of agriculture and cattle raising. It also explains the very intensive land and labour use on the best accessible, most productive land with irrigation facilities.

- Production for household consumption (agriculture) and market (cattle raising).

- Negligible dependence on external inputs (i.e. from outside the farmers community), markets and resources for farm operation. Exchange relations of resources (principally labour but also irrigation water) between farming households are crucial in the operation of farms.

- Multiple income activities and seasonal emigration of farming household members to supplement income, to improve living conditions and to invest in the farm (land, cattle, machines, irrigation facilities).

Two climatic factors determine the need for irrigation. In the dry summer, large water deficits occur (up to about 200 mm/month). A crucial factor in irrigation development which justifies the distinction between the two agro-ecological zones, is the water availability which is significantly higher in the mountainous areas than in the high valleys. Also the production orientation is a determinant factor to assess the relative importance of irrigation. In the high valleys where milk production is dominant and as a consequence more and better cattle feedstuffs are required, irrigation of annual forage crops is very important. In the winter period (night) frosts occur frequently (60-80 frostdays/year). Irrigation of natural meadows ("Rega de lima") is very important, specially in the mountain areas, not only because of frost protection but, from the farmer's viewpoint, also because of the manuring value of the water and management of the meadows (control of vegetative growth and flora composition).

METHODOLOGICAL ASPECTS

From the objective of the inventory study, namely the development of a typology for adequate interventions and strategies, it follows that the research needed to be focussed on the actual functioning of FMIS, both those which have had interventions of external assistance and those which have not. The nature and effects of actual interventions need to be taken into account to identify relevant elements of improved intervention strategies.

The Uphoff-matrix of irrigation system activities was used as a basis to gather and systemize data on management of FMIS at the village level. Two questionnaires were developed and tested for this purpose: one to provide an inventory of all water sources and irrigation facilities at the village level, another to provide specific, detailed information on the functioning of the most important communal system. A communal system here is defined as the FMIS to which all or at least the majority of the households in a village have use access in the summer period.

In the first phase of the inventory work, 24 villages were visited in threemonths (January till March 1992). The research had clear aspects of a rapid appraisal. Each visit consisted of two days. This was considered as a compromise between depth and speed. Field work was mainly carried out by two teams, each consisting of a Dutch and a Portuguese researcher.

The criterion of selection of the villages was to have a sample of villages which is fairly representative of the research area. Selections were stratified to include systems which had and did not have external assistance interventions. Systems from both ecological zones were included in the research as well. However, Mountain systems and intervened systems are over represented. The selected villages are shown in Figure 1.

The method of data collection and processing concerning a village and the local communal system consisted of:

1) gathering secondary data about the village (physical, meteorological, demographic, agricultural etc.);

2) field visits which included semi-structured interviews with representatives of village organizations and farmers, field observations and a walk-through of the communal system; and

3) writing a field visit report consisting mainly of basic village information, a sketch of the communal irrigation system, the results of the two questionnaires (inventory of water resources and irrigation facilities at the village level, detailed information on the communal irrigation system).

In the next three sections, the most important findings of the inventory study will be summarized. It is worth stressing that this research work is still going on. Obviously, refinements or even reformulations of data interpretation might occur.

GENERAL ASPECTS OF FMIS

Generally, a multitude of water resources and irrigation facilities exists within a village. Water sources include small streams, springs, galleries (called "minas", from the Arab influence) shallow wells and deepwells. When summer is progressing, water availability becomes very reduced, especially in the high valleys (scheme flow becomes generally: <<5 1/s).

In this paper, we will first focus on communal systems. In the sample, irrigated areas (summer and winter included) have a range of two to 35 ha per system, the range for water users ranges from eight to 80 per system. Besides the communal systems many smaller groups, family and individual irrigation facilities can be distinguished at village level whose importance on the whole often may surpass that of communal systems, especially in villages situated in the High Valleys.

(Summer) irrigation perimeters are always located nearby the villages. Often they form an authentic man-made terraced landscape with numerous walls. Plots are small (most frequently 0.05-0.1 ha) with extremes of 5m2 to 0.5 ha), often irregular shaped with varying slopes. The plots are constituted by man-made soils which are heavily manured for hundreds of years. These plots are cultivated very intensively in a way that can be best compared to gardening.

In TM almost all irrigation water is applied by gravity methods, namely a special type of controlled flow irrigation (often locally called "rega por embelga") on sandy soils and furrow irrigation on more heavy soils. These methods require considerable skill and labour. Low flow rates imply a very intensive labour use in field irrigation (20-80 hours/ha for one irrigation turn). Application efficiencies are mostly near 100%. (de Castro Rego et al. 1990), which suggest underirrigation. Irrigation intervals in many schemes are too long from an agronomic viewpoint (up to 30 days).

From the analysis of data of the 24 systems some general features related to the construction and management of FMIS can be deduced.

- *Simplicity of irrigation facilities.* An irrigation system consists normally of a diversion structure at the water source, canal and in most cases reservoir. Water distribution structures are absent.

- *Simplicity of operation.* With some exception, waterflows are not divided, so the water user is using the whole flow in the system when it is his or her turn.

- *Few head-tail problems.* Many farmers have small parcels scattered around the irrigation perimeter. Individual water sources often supplement the communal scheme supply.

- *Collective resource mobilization* needed for operation and maintenance is minimal. Normally, water users participate in the collective maintenance efforts only during one day before the summer irrigation starts. At the individual water user level, on the other hand, a considerable amount of labour is needed for operation, routine maintenance, water application and sometimes source and canal patrolling in order to prevent water theft.

- *Absence of formal water users organization.* The day-to-day functioning of irrigation is informally organized. The importance of local leaders, interest groups and organizational issues comes to the surface in strategic moments (e.g. facing the beginning of the summer irrigation period) and for strategic decisions concerning the future of the scheme (e.g. improvement of scheme facilities, change of water allocation).

Aside from these common features, an enormous diversity exists in the functioning of FMIS, an issue that follows.

DIVERSITY IN FMIS: KEY ELEMENTS

An analysis of the data of the communal systems inventoried shows that the diverse functioning of FMIS is most clearly related to the water allocation and distribution[26] in the schemes. The development of irrigation is linked to the development of property rights which define user access to water.

In TM, the traditional irrigation systems were constructed over the centuries by farmers. Most frequently based on the contribution of the systems, farmers claimed user rights of water. These original water rights have changed by inheritance, marriage, buying/selling of land and/or water, negotiations and the external socio-political process. In other systems, the relation between resource contribution and access to water is less explicit, e.g. only separating those who are and are not entitled to use water from a certain source.

In the very heterogenous physical and socio-economic environments of TM, the historical process of irrigation development has resulted in different water allocation principles and water distribution practices in farmer-managed irrigation.

The following water allocation principles in communal schemes during the summer period[27] are found in Table 2 [28]:

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[26] Allocation means the assignment of rights of access to the water among users, while distribution refers to the physical distribution of water among the users (Martin et al. 1987).

[27] Water allocation in FMIS has also clear temporal and spatial dimensions. Generally, water allocation principles are different in the Winter (October-March) and the Summer (June-September). The same applies to the transition period between Winter and Summer. During these periods, in most schemes the free-to-take or/and the "first come, first serve" type of water allocation are gradually applied. These temporal changes are clearly related with water availability and the importance of permanent meadow irrigation. In the Winter, other plots (with permanent meadows) are irrigated by less right holders.

[28] From the table, it seems clear that time shares systems are in the absolute majority. However, posterior empirical evidence shows that in this sample time share systems are over represented in relation to systems with other water allocation principles. In the paper also this posterior experience is incorporated.

Table 2. Summary of water allocation and water availability in the communal systems of selected villages

Village (for location see Figure 1)	Water Allocation Principles	Water Availability Scheme source flow	Agro Ecological Zones*	PDRITM Intervetion ended in:	Remarks/Interventions in system by Water Users (indicated only the most important)
01. Corva	Time shares in August 1992	5-15 litre/sec	M	1992	Conflict with Neighbour Village.
02. Sesmil		0-0.5 litre/sec	HV	1983	Change in Water Rights (1983-85)
03. Vila Cova		5-15 litre/sec	M	1986	
04. Lamas d"Olo		0-0.5 litre/sec	M	1990	
05. Covas		0-0.5 litre/sec	HV		
07. Seixedo		0-0.5 litre/sec	HV		Improvement by water users
08. Tresmundes		0-0.5 litre/sec	HV		
09. Sobradela		0-0.5 litre/sec	HV		Improvement by community
10. St. Marta do Alvao		1-5 litre/sec	M	1989	
15. Fervidelas		1-5 litre/sec	M	1992	
16. Adaes		0-0.5 litre/sec	HV		Improvement by water users
18. Vilela		0-0.5 litre/sec	HV		
19. St. Marta		0-0.5 litre/sec	HV		
20. Aboboleira		0.5-1 litre/sec	HV		Upstream of Bouca (6)
21. Bosto Frio		5-15 litre/sec	M		Improvement by community
11. Meixedo	Equal shares	0-0.5 litre/sec	M		1991 changes in water allocation type 2 to 5
12. Torgueda		1-5 litre/sec	M		Past changes in water allocation type 1 to 2 Improvement by community
17. Santiago	Parcel based	0-0.5 litre/sec	HV	1989	Discussion of water allocations type 3 to 1
24. Vilalva	Free-to-take	0.5-1 litre/sec	HV	1991	Discussion of water allocation type 4 to 1
06. Bouca	First come, first served	0-0.5 litre/sec	HV		Pasrt changes in water allocation type 1 to 5
22. Soutel		0.05 litre/sec	HV		
13. Romainno	Multi level 5	15-25 litre/sec	M	1989	Discussion of simplification water allocation
14. Pincaes	Multi level time parcel	15-25 litre/sec	M		Improvement by commission of "Baldio"
23. Galegos	Multi level time parcel				Improvement by community

* HV: High Valleys
M: Mountainous Areas

1. *Time shares*. The water user is entitled to use the whole scheme of flow for certain time period in a fixed irrigation interval. Rights are unequally divided between water users but are linked to land area.

Water right holders have, in principle, the freedom to irrigate as they like. In practice however, the scatteredness of one's plots in the scheme and the obligation to put the water at the beginning of the time period of the next water user at the entrance of his parcel, can seriously limit this freedom. Because of the fragmentation of land and water rights, in some schemes water right holders have their total time share also fragmented in small periods during the irrigation interval. This has consequences for the organization of labour resources on the farm.

2. *Equal shares*. Every social unit or household in the village is entitled to use the whole scheme flow for a period of time which is equal for every water user. The water users can do with their water whatever they like. To make use of this right, one has to participate in the maintenance of the scheme and/or to contribute to certain tasks of common interest. In some cases, one has also to be resident in the village. As a consequence, emigrants lose the water right till they return to the village. In other cases, even village inhabitants without land are entitled to the same share which can then be transacted then.

3. *Parcel based*. The owner of a specific parcel is entitled to use the whole scheme flow until his parcel is irrigated "sufficiently." In this context, "sufficiently" is a socially negotiable concept. One cannot continue irrigating indefinitely, arguing that the parcel still needs more water.

Comparing this type of water allocation with the former types, some interesting differences appear. In time-based allocation systems the right holder can use the water on whatever crop he likes. In the parcel-based allocation, irrigation of meadows is not permitted because the irrigation method of meadows (contour ditch irrigation or wild flooding) uses much more water than the irrigation methods of food crops. Thus meadow irrigation would prejudice other water users without meadows. Another implication of the parcel-based allocation principle is that the irrigation interval changes with the discharge at the source. When water scarcity is increasing with the progression of the summer, the interval can increase from 8-15 days to more than a month.

4. *'Free to take"*. The owner of a parcel, which can be served by the water source or irrigation canal, has the right to use the whole scheme flow whenever he or she wants. No rules exist. In practice, owners of plots at the head-end or owners of pumps profit most from the water. However, this allocation principle in the purest form does not occur frequently. This principle is frequently found among systems which depend on the same surface water source. It can often lead to conflicts (e.g. Corva).

5. *'First come, first served."* "Free to take" but it is normally arranged with agreements. One basic rule exists: as long as one person is irrigating, he or she will be respected. The other water users wait until that person is finished. This principle has some characteristics of a demand system, but households with more resources than others (e.g. labour force to wait for the water) apparently profit more. Also, restrictions on irrigation

of meadows in the summer exist for the same reason as explained in the parcel-based principle.

6. *Multi-level types of water allocation.* FMIS also have different allocation principles at various levels of some schemes. Irrigation systems have been found with very complex water allocation arrangements (e.g. Romainho). Within this category, most frequently a two-level distribution is found in which water is distributed to groups of water users on time basis and within the group from parcel to parcel. These multi-level types probably did not exist when the schemes were constructed but its emergence was apparently a consequence of an ongoing fragmentation of land and water rights.

Water allocation principles offer differential degrees of flexibility and rigidity of water use at the farm and parcel levels (van den Dries, 1992). Restrictions on crop choice, plots, exchange and commerce of water, are mainly determined by the water allocation principle in the system under consideration. The same is valid for irrigation variables at plot level (e.g., fixed or variable irrigation intervals). The water allocation principle in combination with water availability is a crucial element in farm household decision making concerning land use (crops, plots, intensity) and resource management and allocation (labor, inputs) on the farm.

WATER DISTRIBUTION

In general one could state that distribution practices have been developed to meet the requirements of the different water allocation principles but water distribution is necessarily complex in the diverse micro-environments of TM. Discharges from water sources are often too low to irrigate directly. Conveyance losses in the canals are often too hihg to enable water storage. Through sale and inheritance, water rights become fragmented which is associated with division and scatter of parcels.

In many cases, the result of these factors is that water for an individual water user becomes almost unmanageable, e.g. it is impossible to irrigate a single parcel in, say, half an hour, especially if it is located 800 m from a water source with a discharge of 1 /1s and with an unimproved earthen canal. Water would never reach the plot.

Another effect of the fragmentation of plots and water rights is that relative water scarcity increased. Formerly one landowner had more flexibility to make a plan for the summer period, which plots to sow with what crop, individually taking in account his prospects in relation to water availability (H. Bleumink and M. Kuyk, 1992)

In recent times, water users have developed a set of complex group mechanisms, rules and practices to distribute the water and to manage irrigation. These are products of history and tailored to the specific local situation and conditions of each irrigation system. This makes the management of these systems a local art.

Water distribution is not an independent tradition on its own but is part of the local complex of social relations, agricultural strategies, water availability and water rights. It is in this complex that interventions to assist farmer managed irrigation systems occur. Without some understanding of these inter-relationships, interventions are likely to create uninteded effects.

INTERVENTIONS IN FMIS

One may say that FMIS in TM are relatively successful in achieving the objectives for which they were created. This is apparent given their long existence and continuing use, which demonstrate their sustainability and resilience to change.

FMIS are dynamic systems which respond to the changing needs of users. Farmers try to adapt, change and improve their schemes. Attempts to overcome constraints in the environment and rigidities in the functioning of the schemes are often made by farmers.

If the schemes do not or cannot respond satisfactorily to the needs of water users, farmers also look individually or in small groups for opportunities outside the communal schemes in order to develop their own water resources and strategies to obtain water.

Evidence shows that water users themselves actively intervene in irrigation development, both inside and outside the communal systems. In this paper we will distinguish the following types of interventions.

Adaptation. Within the limitations and rigidities of a particular system, water users try to make the most out of generally small quantities of available water. Many strategies can be distinguished. Water distribution is made more flexible through exchange of water turns, or more broadly, the exchange of different resources (e.g. labour against water etc). Water users explore opportunities to make individual or group arrangements among them within the limits set by the management principles and physical constraints of the systems. Water and/or land of emigrants is used by other water users through various arrangements. A range of local agronomic practices are used for adaptation to, or escaping from, various degrees of water scarcity. This interplay has developed into another local art form. Examples of such adaptations are crop combincations, rotations, varieties, sowing and harvest times, and plant densities.

Changes in Water allocation principles and water distribution practices. In some schemes, examined in the inventory, farmer communities have changed management practices and in other schemes discussions are taking place to change the actual water allocation principles (see Table 2). It is understandable that these changes are the outcome of a complex social process because this type of change involves changes in social relations and resources which farming households control. For some groups of water users actual water allocation and distribution is more beneficial than for others. Usually long time periods are needed but changes nevertheless occur. In the village of Sesmil, the improvement of the communal systems by PDRITM was used as an opportunity by a group of water users headed by a local leader to change the distribution of water rights through linking the new distribution of water rights to the labour contribution of water users in the improvement works.

Events such as transactions and division by inheritance of land and/or water are equally used as opportunities for change.

In some systems observed, water allocation and distribution is viewed by an increasing number of water users (principally young people) as too complicated. In Vila Cova young water users are regularly consulting older farmers about the periods they have access to water. Besides being complicated, the actual water distribution is very time consuming. Some water users have numerous short turns for fragmented holdings which are sometimes spread over 11 days (which is the irrigation interval).

Improvement of irrigation facilities. The largest physical constraint in many irrigation schemes in TM is the scarcity of water at the scheme and field levels. Numerous partial improvements of irrigation facilities implemented by farmer communities themselves have been found. Two types of improvements can be distinguished. First, attempts to limit losses in the canals and reservoirs by means of lining and secondly, to get more water by developing existing and new water sources. These improvements in many cases are supported by local organizations such as the "Junta de Freguesia" (the political-administrative unit of the Portuguese government at the lowest local level) or the "Commissao de Baldios" (Management Commission of Communal Wasteland).

Individual Water Resources Development. For many years, farmers developed their own water resources, such as springs, wells and galleries. Two developments have enormously accelerated in some regions, in the high valleys where the search for water and the development of private water sources especially is intensifying. These are the impact of emigration and the availability of modern technology.

One of the impacts of returning emigrants, principally in the 70s and the early 80s, was that they brought back with them capital used for investments in water source development on an individual basis. At the same time, new technology became available that supported this type of development.

Long PVC tube lines made it feasible to transport small quantities of water from long distance water sources to the best plots near the villages. This supplemented available water from the traditional systems and/or decreased dependence on the traditional communal systems. This stimulated the creation of small enterprises to develop water sources and to dig trenches for the tubes. Other technologies used widely in TM to reinforce available water quantities is the deep tubewell and electric motor pump. The development of sources for drinking water and the construction of supply lines to homes is also quite recent. The dynamics of the rush for the exploitation of water sources has even led to situations in certain villages in which existent irrigation schemes are being undermined and the available water for these schemes is diminishing.

This is happening in some cases to such a degree that some communal systems virtually have become defunct. This problem is further aggravated by two factors. One is the effect of emigrants who spend holidays in August in their villages. The population of a common village will sometimes double or triple during this period. The combination of this sudden population increase and more demanding water consumption habits leads to high requirements during one of the driest months of the year.

State Interventions

An important development since 1982 has been the involvement of the Portuguese government in irrigation development in Tras-os-Montes, financed by World Bank loans and structural adjustment funds of the European Economic Community. The government-supported programme for irrigation development consists of two components.

1) *Improvement of traditional irrigation schemes.* The PDRITM intervention program for improvement of communal FMIS aims at developing intensive dairying based on increased forage production. The type of intervention is conceptually not very different from the initiatives which the farmer communities already by themselves have undertaken.

   Contrary to some other rehabilitation programmes worldwide, it respects the existing local situation with its intricate complexities. So, the interventions don't change the functioning of the irrigation schemes but focus on the improvement of the physical infrastructure of the schemes, essentially by limiting water losses by lining of canals and reservoirs. Improvement will only be implemented if at least two-thirds of the water users agree and subscribe to the respective protocol. Direct resource contributions (labor or other) of the water users are also required (5 to 20% of the value of the total investment).

   The implementation process and the effects of the interventions of the PDRITM programme for improvement of traditional irrigation systems are extensively documented (Portela et al. 1985, 1987, 1990). In this paper we will summarize the most important conclusions:

   - Surveys indicate that water users agree that the PDRITM interventions produced multiple benefits both at farm and village levels. (These are mainly diminished summer water scarcity and less labor required for operation and maintenance.)

   - Design errors are identified by water users in some villages (principally in the mountain zone). Canals were sometimes designed for supplementary irrigation or were substituted by tubes. These canals and tubes disrupted winter irrigation (which has to be done with larger raters of discharge with often more silted water). This reportedly reduced the yields of permanent natural pastures.

   - Government interventions have had generally modest impacts which have mainly been small increases of water availability at scheme source level.

- The selection and prioritization of schemes for intervention is not very systematic and is subjected to pressure of political power groups. Selection criteria are more based on the convenience of the implementing agency. Actual water management and the productive potential of a scheme plays a minor role. It can be shown that a standardized type of intervention, namely the improvement of irrigation facilities, leads to different results in irrigation schemes which have different water allocation principles (van den Dries, 1992). This leads to differential production effects from incremental increases in water in the various schemes.

- Water users are usually not involved in the planning and design phases of the intervention. This leads to conceptual errors in the design and to unnecessary problems and delays in the implementation phase.

2) *Construction of new small-scale irrigation systems.* The most salient aspects of newly constructed systems are:

   - The process of planning, design and construction of the scheme is essentially an external intervention with nearly no participation by future water users.

   - There is an increase in summer time water availability through the construction of small dams and storage tanks (in the order of a million m3 per scheme). In this sense, the intervention responds to one of the most commonly felt needs of farmers, more water.

   Not much experience is yet available woith construction of new small-scale schemes but PDRITM will in the future focus on these type of schemes more and more.

We will now address the question of which elements can be considered as building blocks for intervention strategies as a model for assistance programs.

BUILDING BLOCKS OF A MODEL FOR INTERVENTION STRATEGIES FOR FMIS

The inventory study shows clearly the existence of different development patterns of farmer-managed irrigation, some bing communally and others being individually managed.

In some places these tendencies are parallel developments, in other places individual irrigation development undermines communal systems which consequently lead to a decline in performance and sometimes to a complete abandonment of communal schemes. This last phenomenon is occurring most clearly in the zone of the high valleys. In the mountain areas farmers invest also in individual irrigation facilities. However, communal systems are still the most important type at the village level. These patterns are clearly related to the balance between water needs of the farmers and local water availability.

In future institutional interventions, these development patterns need to be considered in each locality. This points to the necessity of consultation with the farmer community to develop an integrated approach to local irrigation development. As an outcome of this approach a whole range of interventions need to be considered, not only improvement of the physical infrastructure of communal systems Such an integrated approach implies that intervention doesn't need to be limited to one village but can be extended to a catchment area in the case where various irrigation systems depend on the same surface water resource or even to a whole region where groundwater development is relevant. One constraint on development at the level of a resource area is the obsolete Portuguese water legislation and deficient application (Matos Ferreira, 1989).

A typology of FMIS for intervention purposes in communal systems can be constructed on three fundamental principles, or building blocks. These are allocation principles, water availability and water distribution practices. This typology can contribute to defining the contents of intervention (what to do). These elements are operational in the sense that they can be changed. As mentioned above, interventions implemented by water users themselves nearly always concern changes in these elements. They can also be linked to (certain) contextual and environmental factors (e.g. agro-ecological, production orientation etc.) related to regional planning purposes. Institutional interventions by state agencies, collective organizations can contribute to realizing these changes.

Another relevant question is the implementation process of interventions ("the who and how" questions). The fact that farmer communities, in many cases supported by other local organizations, actively intervene in irrigation development is of crucial importance. It is an indicator of the capacity and decision making of water users and their organizations to create and change things. It represents a potential that is actually not used by external interventions. We think that this resource can be combined with external efforts to improve interventions through an approach similar to what Coward has called, "*the indirect investment approach*". Through indirect investment, critical resources are provided by state agencies to local irrigation groups to create and improve those locally owned and managed systems (Coward, 1985).

CONCLUSIONS

Inspite of its "*rapid appraisal*" nature, the methodology used in this inventorysutdy has given satisfactory results. However, qualifying information of different actors needs to be strengthened. Because of the quantity of information gathered more time needs to be spent for data processing and analysis. The difference in professional background (irrigation engineers vs. agronomists/sociologists) and experience was not an obstacle but, on the contrary, a stimulus for collaboration.

The inventory study proved to be powerful tool in gaining insights into FMIS, their management features, problems, potentialities and the environments in which they are located. It permitted identification of what was going on in the traditional irrigation sector of the mountain zones and high valleys and identification of important problems to focus on. The inventory study was very useful for the selection of case study sites in accordance with identified research priorities.

It is our conclusion that if groups of water users (who ultimately are the risk-takers of irrigation investments) are given their due status and roles they can make themselves accountable before external actors and can productively contrinute their own local knowledge and resources.

The irrigation infrastructure of a village forms a complex network of different water sources, reservoirs, canals and fields dispersed around the village territory, which at the first sight gives an impression of chaos. One is struck with the simplicity and practicality of irrigation facilities, their operation and the very informal day-to-day management. It looks as if a secret covenant is putting everything in order. In reality FMIS and their functioning is the concrete expression of accumulated collective experience and the outcome of a historical process with its dynamic dichotomies of adaptation vs change, observation vs action, confronting constraints vs realizing potentialities and opportunities - all in an arena with different actors in a locally-unique physical environment.

Three key factors are considered determining elements in explaining the enormous diversity among communal systems and their environments. Water allocation principles, water availability and, to a lesser degree, water distribution practices have been identified as basic building blocks for the construction of a model for intervention purposes. Interventions by groups of water users or government agencies always involved change in one or more of these elements.

In our opinion to optimize the benefits of external interventions for the development of farmer-managed irrigation, the following strategic elements are important:

- Developing an integrated approach to local irrigation development.
- Linking this approach with actual interventions implemented by water users and local organizations.
- Combining the implementation capacity and decision making of local water users and organizations with critical resources made available by state agencies and other institutions in an indirect investment approach.

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This paper is based on the contributions and experience of several people. First of all, the farmers who continue to make the most out of scarce land and water resources in a harsh environment. These inventive and prosaic people shared their experience with us and have received us with warm hospitality. Hans Bleumink, Nuno Gusmao, Michiel Kuik and Paulo Morgado who formed the group of Portuguese and Dutch researchers, did the bulk of the fieldwork, data processing and analysis upon which this paper is based. Other collaborators of the irrigation systems research group contributed to our better understanding of some aspects of irrigation development in Tras-os-Montes.

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ANNEXES

Annex 1
Workshop Programme

The workshop was held at the Development Academy of the Philippines (DAP), Tagaytay City, Philippines.

Monday, 12 October 1992

17:00 - 19:00	Registration followed by an informal gathering		

Tuesday, 13 October 1992

08:00 - 08:30	Registration (continued)		
08:30 - 09:30	Opening Session		
	Dr. Jose A. Galvez	-	*Opening Remarks*
	Mr. Franz Heim	-	*Introductory Note*
	Dr. Shaul Manor	-	*Introductory Note*
	Dr. C. M. Wijayaratna	-	*Objective of the Workshop*
09:30 - 10:00	Coffee		
10:00 - 12:00	Plenary Session		
	Engr. Benjamin U. Bagadion	-	*Chairman*
	Title: Synthesis Presentation		
	1. Dr. Honorato L. Angeles		
	2. Dr. Sjofjan Asnawi		
	3. Dr. Ruth Yabes		
	4. Dr. Ujjwal Pradhan		
	General Discussion		
12:00 - 12:15	Dr. Shaul Manor	-	Guidelines for group
	Dr. C. M. Wijayaratna	-	Discussion
12:15 - 13:45	Lunch		
13:45 - 16:30	Group Discussion		
18:00 - 18:30	Introduction of NIA Regional Office IV Officials and Senior Staff		
18:30 - 21:00	Reception and Dinner		

Wednesday, 14 October 1992

07:30 Field Trip

Field visit to two Communal Irrigation Systems (CIS) in Laguna. This will include meeting the farmers, Provincial Irrigation Engineers and other agencies which have potential interests in such inventory and MIS, either planners or service providers.

The FMIS workshop participants will be divided into two (2) groups for the field study. One group will visit the Balanac RIS in Pagsanjan, Laguna which is about 2 hours drive from the Development Academy of the Philippines (DAP). The other group will visit the Bugaan CIS in Laurel, Tanauan, Batangas which is about an hour drive from DAP.

The two groups will proceed to the respective Irrigators' Association office or the Association warehouse.

Introduction about the study sites will be given by Engr. R. Bonrostro, Regional Manager of the NIA in Region 4, Engr. Medina, Regional Division Manager of Region 4, Engr. Cafe, Provincial Irrigation Engineer and Engr. Anonuevo, Irrigation Superintendent of the Balanac RIS.

The field visit to the selected systems will include the following activities:

1. Orientation about the system by the Irrigation Superintendent of the Balanac RIS and the Provincial Irrigation Engineer of the Bugaan CIS.

2. Technical data (which includes: layout maps/parcellary maps, monitoring form of the IMIS, etc.) prepared by the National Irrigation Administration Regional Staff will be presented. A profile of the system (Balanac RIS and Bugaan CIS) which includes some performance indicators will be distributed.

3. Orientation about the Irrigators' Associations, Balanac River Irrigation Systems Irrigators' Association (BRISIA) and Eastern Bugaan Poblacion IA, Inc. by the Association officers.

4. Institutional data (which includes: IA profile, Organizational structure of the IA, list of functions of the IA Board of Directors and officers, etc.) will be presented by the farmers.

5. The Turnout Service Area Leader (TSAL) will present their involvement in accomplishing the IMIS forms. The farmers will also discuss the flow of IMIS forms from TSAL to the Water master.

16:00 - 18:00 Group Discussion

Thursday, 15 October 1992

08:00 - 12:30	Group Discussion (continued)		
12:30 - 13:30	Lunch		
13:30 - 15:00	Plenary Session	-	Group Presentation and Discussion
	Dr. C. M. Wijayaratna	-	*Chairman*
	- *1st Group*	-	*20 minutes*
	- *2nd Group*	-	*15 minutes*
	- *3rd Group*	-	*10-15 minutes*
	Plenary Discussion	-	*45 minutes*
	Remarks (Chairman)		- *10 minutes*
15:15 - 15:30	Closing		
	Response from one of the Participants		
	Vote of Thanks	-	Dr. Shaul Manor
15:30 - 16:00	Coffee/Tea		

Annex 2
List of Participants

	Name of Participant	Home Address	Office Address	Fax Number
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Annex 3
Discussion Group Reports

Group 1
The River Course Level or Multi-System Approach to Inventory and MIS

An irrigation inventory consists of collecting similar information systematically of the systems within the area of interest. There are a number of reasons why it is desirable to make an inventory of irrigation systems along a watercourse or a subterrain basin. One or more reasons may be fulfilled simultaneously. In some cases, the purpose may be only identification of all systems with very basic data collected. For some purposes more extensive data collection is necessary.

REASONS FOR MAKING AN INVENTORY OF IRRIGATION SYSTEMS ON A RIVER BASIN

To improve river basin level resource management

1. Identify existing irrigation resources;
2. Identify non-agricultural, competing uses;
3. Determine resource mobilization for maintenance;
4. Determine intersystem institutions (along river course/within aquifer) water rights;
5. Plan or implement water rights legislation;
6. Monitor environmental change/degradation; and
7. Support development of basin-level management entity.

To improve support services

1. Plan strategy for assisting FMIS;
2. Determine relative assistance needs among systems:
   - physical; and
   - management/institutional; and
3. Prioritize systems for assistance.

To improve irrigation management

1. Identify existing prototype management patterns; and
2. Plan for system turnover.

To select research sites

1. Identify characteristics intended for study

VARIABLES, MEASURES AND INDICATORS USED IN IRRIGATION INVENTORY

PHYSICAL

System Identification

name(s) of system
relative location (village)
water source(s) used (stream, groundwater, spring, etc.)

Description/ Condition

water acquisition technology
location of intake(s)
condition of intake/weir
water distribution technology among systems & within systems
civil structures (type, number, size, length)
condition of structures
canal length
landslide areas
stream crossings
water logging
draw-down of aquifer
drainage facilities

Water

competing non-irrigation water demands in the basin
water availability each season
water quality
return flows
aquifer area, depth, seasonal variation

Land

irrigable area
irrigated area by season
land use patterns
land degradation

Watershed Related

catchment area
number of systems along rivercourse
(secondary source to be field checked)
density of systems (number per kilometer along river course)
river length
river slope

inter sector water use/management
rainfall patterns
denudation of catchment area

INSTITUTIONAL

General

type, amount, pattern of resources invested in system
land tenure (% of owners/tenants)

Organization

who manages system
system ownership (FMIS, Joint, Agency)
administrative boundaries
years of existence
institutional arrangements (bylaws, rules, roles, committees, organizations; structures, registration, sanctions)
number and types of rehabilitations
number of members/users
coordination between systems
type of training programs

Operation and Maintenance

river training needed/accomplished
functionality of structures
farmer perceptions of management constraints/problems
farmer suggestions/priorities for improvements
amount, frequency and duration of labor for repair/rehabilitation

Water Use

water rights and laws (within and among systems)
conflicts and sanctions (within and among systems/sectors)
water allocation (within and among systems)
existence/payment of water charge

AGRICULTURAL

General

land preparation/planting/cultivation practices
marketing and transport facilities
gender roles in agriculture and irrigation

Crops

cropping pattern
cropping intensity
crop varieties
crop yields
crop seasons

Inputs

agricultural inputs/use
loan dependency
seasonal water demand from river source/groundwater basin
water adequacy and timeliness
degree of staggered planting
labor availability and mobility

Production

planted/harvested area
profitability
relative subsistence/market orientation

MAKING INVENTORY RESULTS AVAILABLE: OUTPUT FORMATS

1. *Analytical Report.* Analysis and synthesis, identification of priorities or subset of FMIS for potential intervention.
2. *Maps and schematics* showing spatial relationships and key indicators.
3. *Narrative descriptions* of each FMIS.
4. *Matrix.* List of FMIS with columns showing indicator information, e.g. in an inventory book.
5. *Diskette.* Matrix information in, e.g. Lotus 123 format.
6. *Database.* Allowing easy search, ranking and selection of subsets of information.
7. *Management Information System (MIS).* Database + procedures for updating and decision-oriented reports at different levels.
8. *Geographic Information System (GIS).* Irrigation MIS + locations on digitized maps and links to other non-irrigation databases.

According to users: Farmers
Agency
Others . . . .

INSTITUTIONAL SETTING

Farmer-managed

- Inventory conducted by farmers
  Used by watershed forum of FMIS representatives

Jointly managed (farmers & agency)

- Periodic undertaking
  Used by: Basin Management
  A specific project
  An Agency (routine or for specific activity)
  Planning agency
  Donors
  NGOs: Academic Research, think tank agencies/ institutions

NGO managed

- Periodic undertaking
  Used by all above & donors

Company/ individual managed

INSTITUTIONAL SUPPORT

- Not a special unit
- Legal support
- Prototype, then expand according to areas of interest*
- Procedures for updating
- Routine budget and ways to bill project
- Access to secondary data
- Equipment: cameras, computers
- Systems should also be usable without computers- paper only
- Transport
- Training: Manuals, etc.

* Dimensions

- Showing utility of inventory
- Specific indicators

OBJECTIVE NO. 2: DEVELOP METHODOLOGY FOR DATA COLLECTION, PROCESSING, ANALYSIS, COMMUNICATION AND USE

PREPARATION

1. The selection of rivercourses for the inventory based on the objectives of the inventory.
2. Questionnaires for the inventory include a common set of indicators for irrigation systems and MIS
3. Field staff selection, preparing topographical map and other field equipments

   Types of skill needed are:
   - to read topographical map and the availability of the map
   - to interview
   - to estimate the size of the command area
   - to make simple maps and schemes for reporting

DATA COLLECTION METHODS

1. Secondary documents
2. Rapid Rural Appraisal
3. Participatory Rural Appraisal (includes meeting)
4. Survey Instruments and Structured Interview
5. Inventory Check List
6. Sketch Mapping
7. Aerial Mapping
8. Satellite Photography
9. Geographical Information System (GIS)
10. Walkthrough along the river from downstream to upstream

PROCESSING, ANALYSIS, COMMUNICATION AND USE 'METHODS'

AIM: How to get collected information back to:
1) Farmers
2) Policy makers
3) Practitioners

in a usable and accessible form

Cross-Cutting Factors: Manual, computer techniques and overall purpose of MIS

1. Key informant documentation/notes
2. Tally (frequency, ranking)
3. Coding/codebook for processing
4. Map interpretation and refinement
5. Information verification
6. Codebook (flag, tag & sort) for analysis
7. Report preparation focused on three levels of: policy makers, practitioners and farmers (includes forms, maps of rivercourse systems, tables and matrix).

METHOD TO BE USED ACCORDING TO REASONS FOR INVENTORY

I. *To improve resource management*

A. **Data Collection Methods**

1. Secondary Documents
2. Participatory Rural Appraisal (includes meetings)
3. Survey Instruments & Structured Interviews
4. Inventory Checklist
5. Sketch Mapping
6. Aerial Mapping
7. Satellite Photography (if available)

B. **Processing, Analysis, Communication & Use methods**

1. Key informant documentation/notes
2. Tally (frequency, ranking)
3. Map interpretation & refinement
4. Information verification
5. Code book (flag, tag & sort) for analysis
6. Report preparation

II. *To improve support services*

A. **Data Collection Methods**

1. Rapid Rural Appraisal and all of I-A

B. **Processing, Analysis, Communication & Use Methods**

1. Coding/code book for processing and all of I-B

III. *To improve Irrigation Management*

A. **Data Collection Methods**

1. Secondary documents
2. Participatory Rural Appraisal (includes meeting)
3. Survey Instruments & Structured Interview
4. Inventory Check List

B. **Processing, Analysis, Communication & Use Methods**

1. Key informant documentation/notes
2. Coding/code book for processing
3. Map interpretation & refinement
4. Information verification

IV. To select research sites

A. Data Collection Methods

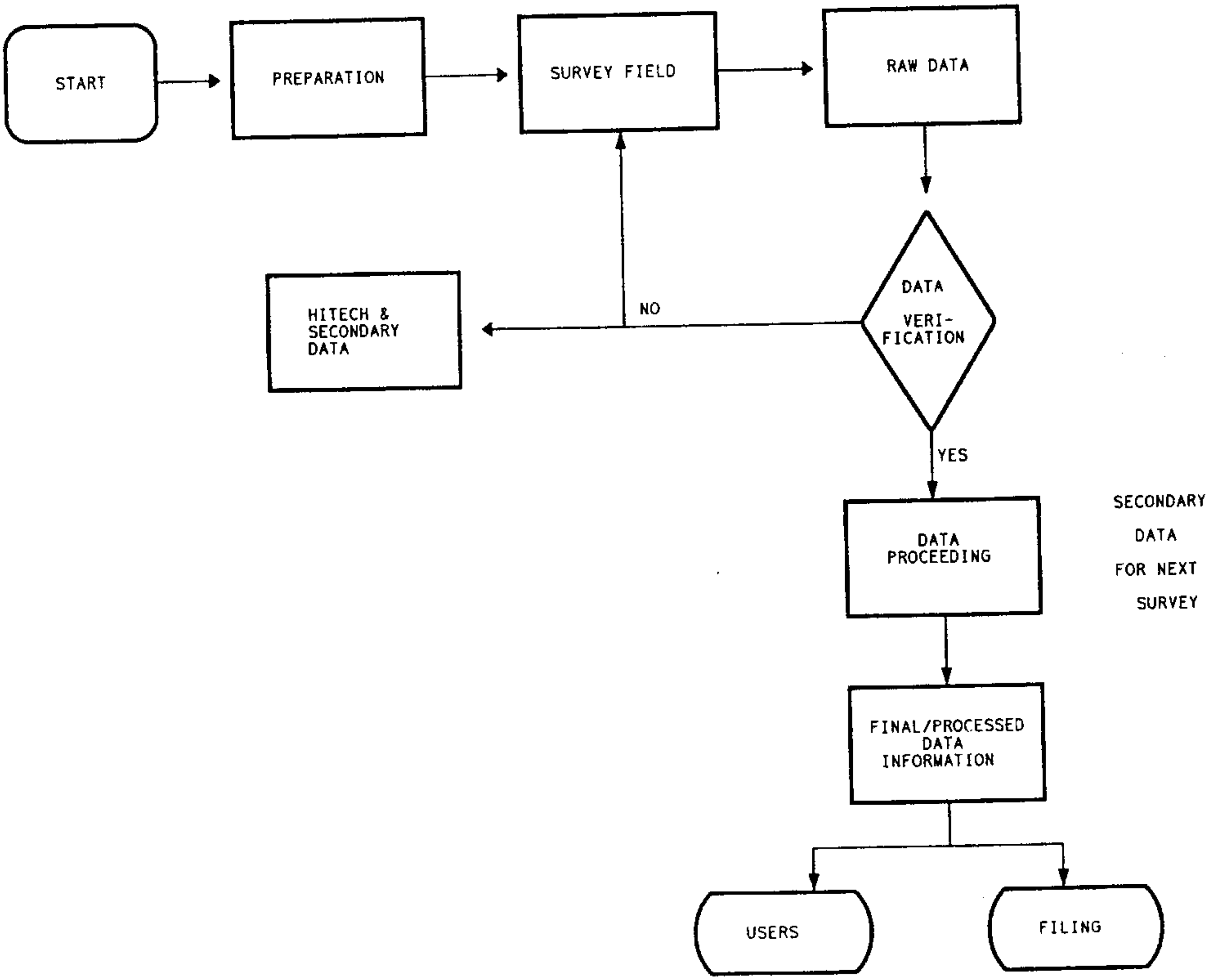
All of II-A

B. Processing, Analysis, Communication & Use Methods

All of II-B

Flowchart: Farmer managed inventory system

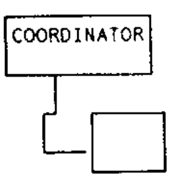
A. INTERNAL SYSTEM



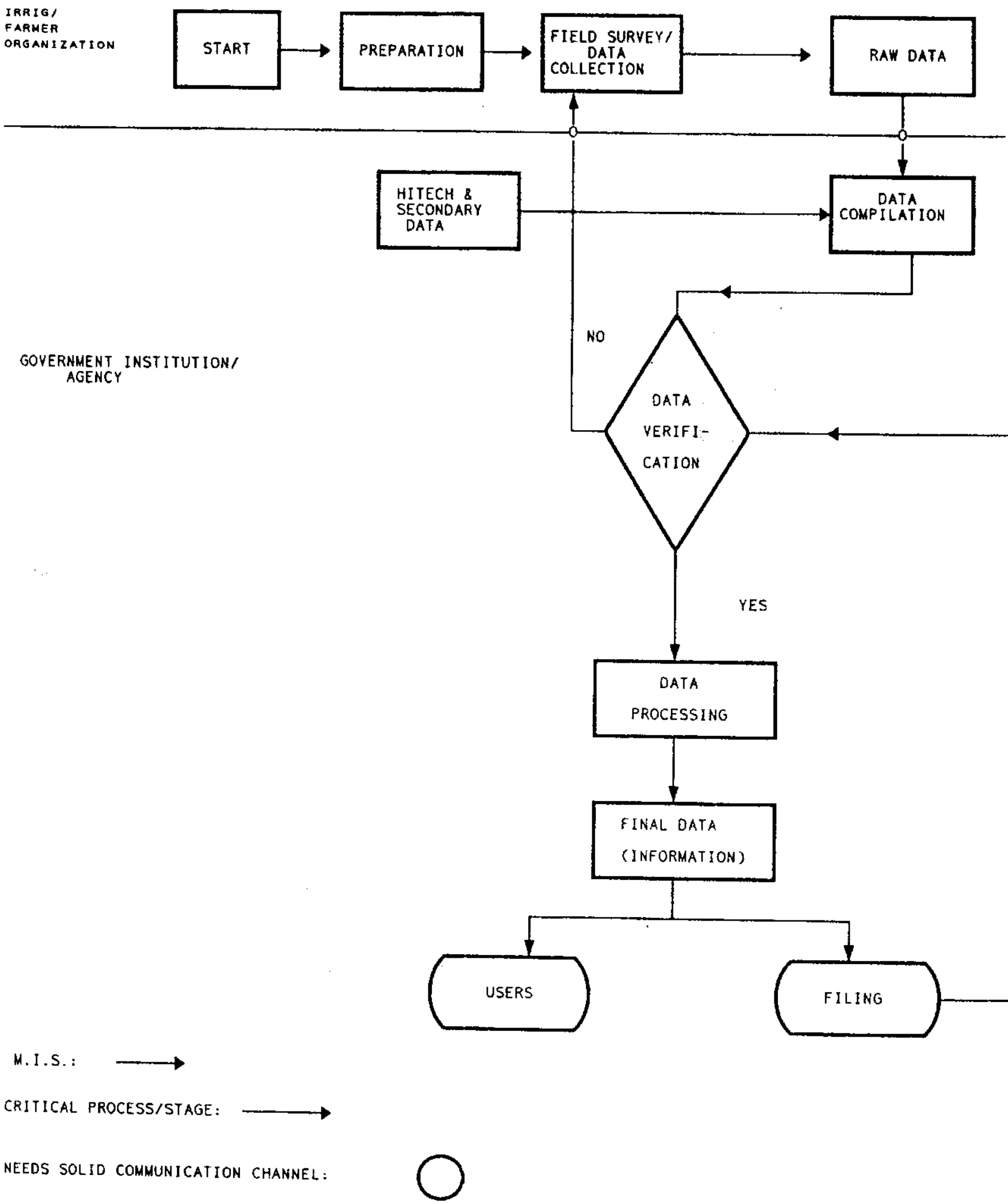
M.I.S. ______

CRITICAL STAGE/PROCESS ☐

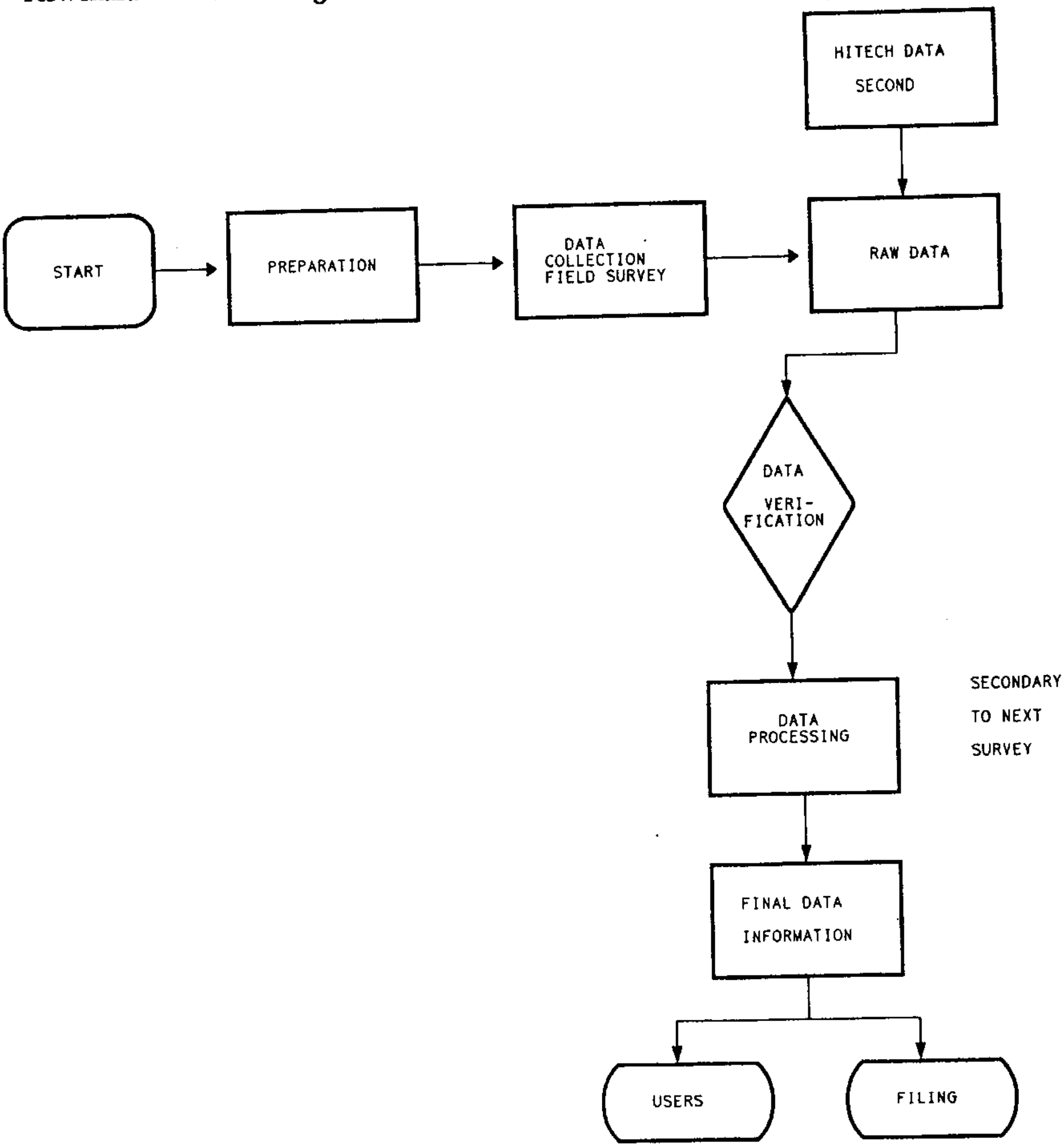
B. INTERSYSTEM



Flowchart: Jointly managed (farmers and government)



Flowchart: NGO managed

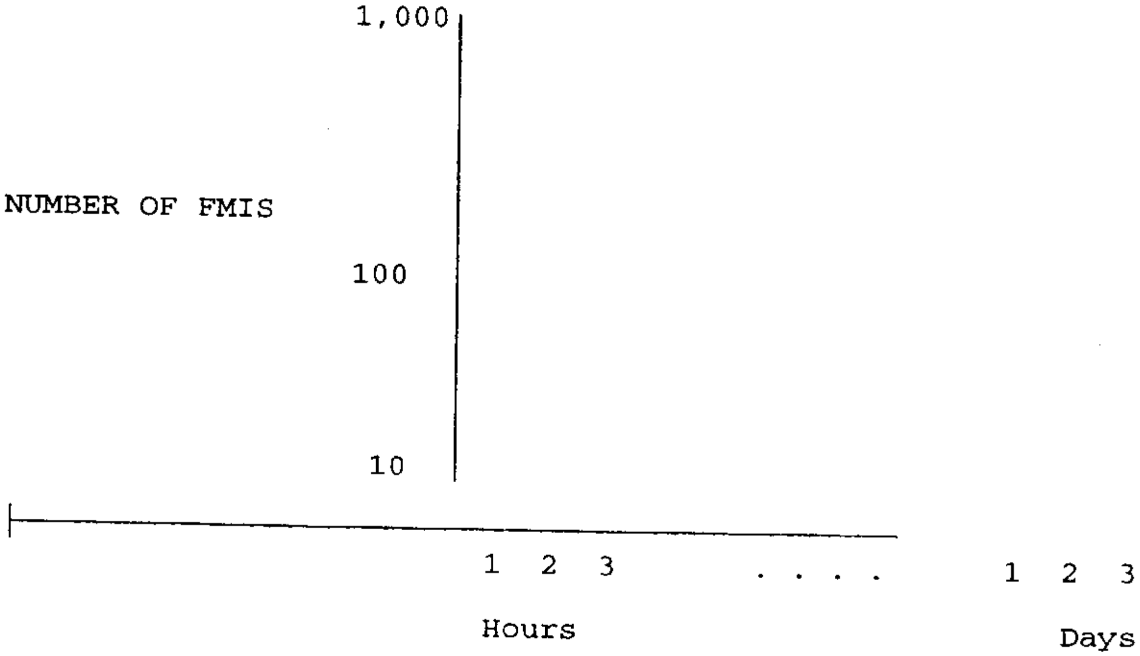


M.I.S. ⟶

CRITICAL STAGE/PROCESS ——

CONSTRAINTS:
- BUDGET/SPONSORSHIP
- LEGAL/POLITICAL
- CONTINUITY

Time to collect data per FMIS



Group 2
The Systems Level Approach to Inventory and MIS

The initial discussion explored the reasons why an inventory would be undertaken and what is its ultimate objective.

* Why is an inventory undertaken?

  - To prepare long term program for irrigation development
  - For project identification and project prioritization
  - To improve O&M, increase production and income
  - It is required by the donor agency
  - To improve FMIS performance

* Who shall undertake an inventory?

  - Government
  - FMIS

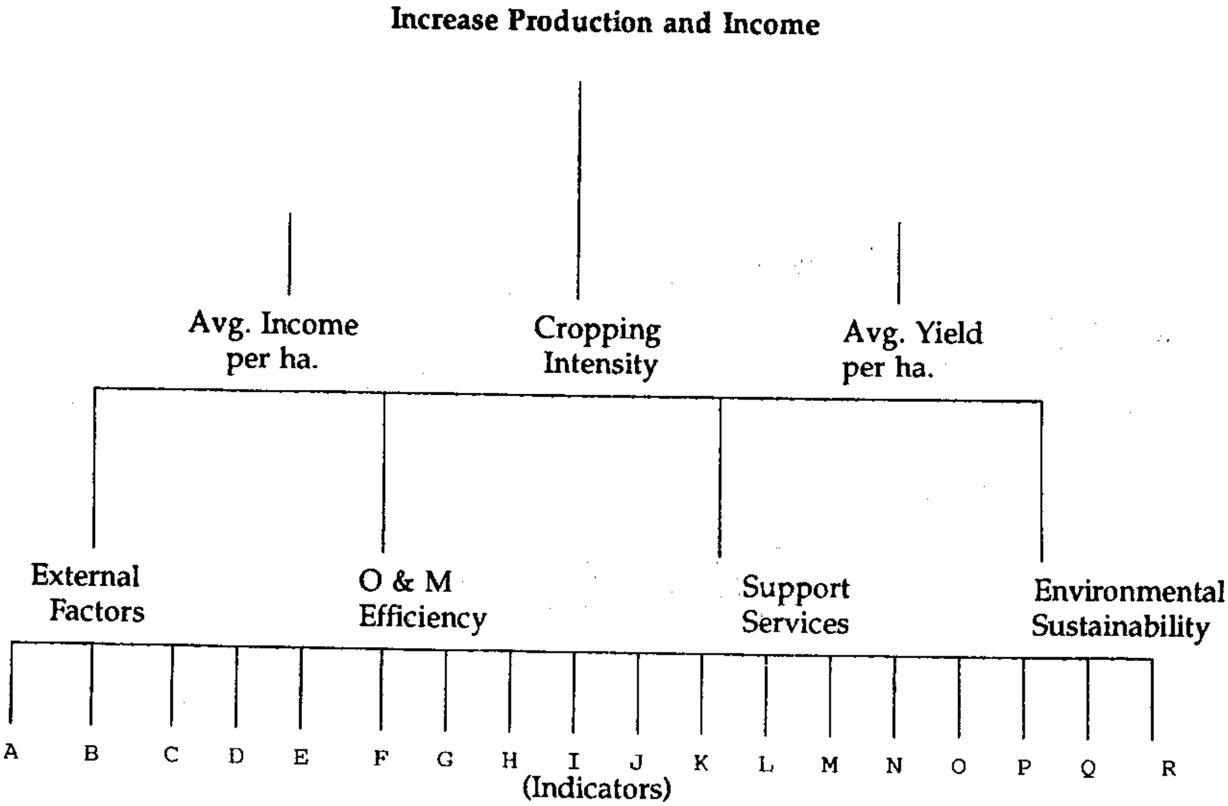
* Scope of inventory

  - Systems level, river basin, district, province, or beyond depending on purpose, time frame and cost

After the preliminary discussion, the group agreed to set a common objective for inventory. This objective could be on the perspective of the FMIS or that of the agency. At the FMIS level, the purpose of the inventory is anchored on the FMIS objective which is to increase production and income. On the part of the agency, it could also be the same objective but looking at the relative performance or FMISs at the river basin level. In this context, indicators that need to be captured are those relevant to performance measurement such as average yield/hectare, cropping intensity, average income per hectare and the like. The next level of indicators pertains to factors that exert influence on FMIS performance which include, among others, external variables, O&M efficiency, support services and environmental sustainability.

These in turn are affected by immediate factors which would then be the indicators that need to be covered in the inventory process. The framework for the process of identifying indicators for FMIS inventory and MIS development are presented in Figure 1 along with the FMIS/MIS indicators.

Figure 1 **Conceptual model for FMIS inventory and MIS development**



Indicators

A Command area: potential, actual
B Topographical characteristics
C Soil types and related soil characteristics
D Water source
E Climatic condition
F Irrigation facilities
G Drainage facilities
H Land use
I Road network
J Support facilities (e.g. ricemills, driers etc.)
K Demographic characteristics
L Organizational characteristics of FMIS
M Support organizations
N Level of assistance received by FMIS
O Agro-economic data
P Water allocation and distribution arrangement and water rights
Q Financial management
R Maintenance system

Methodology for Data Collection, Processing, Analysis

- rapid appraisal
- survey
- investigation
- feasibility studies
- spotmapping technique, tapping knowledge of farmers on local setting
- self-assessment technique
- walkthrough within the system and beyond
- actual interview
- parcellary mapping, paddy/aerial view
- hydrology: float method, current meter, staff gage, standard measuring devices

The ultimate choice of methodology to be adopted depends on the cost and timeframe for the inventory. The data gathering technique should be practical, simple and effective in capturing the information desired. It should also be affordable. Ideally, there are desired sets of indicators that should be collected for each FMIS. The FMIS need to capture detailed data particularly for planning purposes. Inventory on a broad scale could not be done repeatedly, so the design for data requirement and collection should be the utility of the data in assessing the attainment of FMIS goal. The suggested format for collecting the data either for inventory or MIS are presented in Tables A to Q.

Table A **Command area**

Name of Farmer	Lot Number	Tenurial Status	Size of Holding	Whether Irrigated

Table B **Topographical characteristics**

Hilly, Rolling or Plain

Table C **Soil type**

Soild type as per the local classification

Table D **Water source**

Type of Source	Surface Water	Ground Water

Surface Water

Average Flow											
1	2	3	4	5	6	7	8	9	10	11	12

Ground Water

Capacity of Pump	Hours of Operation		
	Wet	Dry	Third Crop

Table E **Climatic conditions**

Average Rainfall and Evapotranspiration																							
1		2		3		4		5		6		7		8		9		10		11		12	
R	E	R	E	R	E	R	E	R	E	R	E	R	E	R	E	R	E	R	E	R	E	R	E

Table F **Irrigation facilities**

Type of System	System Code
Run of river	1
Reservoir	2
Groundwater	3
Conjunctive use	4

*

Type of Structures	Structure Code
Weir	1
V - Notch	2
Diversion	3

Structure Code	Location of Structure
*	**
3	25
2	35
2	25,15

Table G **Drainage facilities**

Same format as for Irrigation Facilities (Table F) can be adopted

Table H Land use

Cropping pattern

Year	Crop	Area		
		Wet	Dry	Third Crop

Cropping calendar

Lot No.	Year	Crop No.	Wet		Dry		Third Crop	
			Start Date	Harvest Date	Start Date	Harvest Date	Start Date	Harvest Date

Table I Road network

Type of Road	Road Code
Metaled	1
Jeepable	2
|	|
|	|

Road Code	Location Coordinates	Responsibility of Maintenance
	*	

* Same structure as used for Irrigation Facilities (Table F) can be used for generating local coodinates.

Table J **Infrastructural and equipment support facilities**

Type	Number	Capacity for Size	Financial Source
*			

*To be decided by the country

Facility	Type Code
Rice mill Drier Warehouse |	1 2 3 |

Table K **Demographic characteristics of FMIS**

Name of Farmer	Ethnic Group	Religion	Number of Members			Number helping in Farming		Educational Attainment		Income from Other Soruces
			Male	Female	Children	Male	Female	School	College	

Table L **Organizational characteristics**

Type of Organization	Code
Formal Informal	F I

Organization Code	Registration	Year Started	Number of Members	Model of Structure	Scope
				*	**

* Detailed model of organization strucutre to be classified by the country.

** Whether organization is dealing only with water management as the single objective, it has multiple objectives.

Table M **Financial management**

Revenue Sub-System

FARMER NAME	YEAR AND SEASON	AMOUNT DUE	PREVIOUS DEBT	CURRENT PAYMENT	BALANCE

Other Revenue

YEAR	COLLECTION FROM WATER	EXTERNAL GRANT	LOAN	PENALTIES	RENTAL	PROFITS	OTHERS

Expenses

YEAR	PAYMENT TO LABOR	CONSTRUCTION	EQUIPMENT	OTHERS

- information whether organization has internal or external audit

Table N **Support organizations**

YEAR	ORGANIZATION CODE	SUPPORT TYPE CODE	EXTENT	REMARKS
	*	**		

* Support Organizations' Data to be generated locally

NAME OF THE ORGANIZATION	ORGANIZATION CODE

**

TYPE OF SUPPORT	CODE

Table O **Agro-economic data**

Lot No.	Year	Season	Yield	Cost of Input			Cost of Equipment	Others
				Fertilizer	Labour	Pesticide		

Table P **Water allocation and distribution arrangement**

Year	Season	Distribution Code	Mode	Number of Applications
		*	**	

* Distribution models to be identified

Model	Code
Continuous	1
Rotation	2
Rotation or Lateral	3
Rotation or Sector	4

** Mode of distribution

Mode	Code
Head to tail	1
Tail to head	2

Table Q **Maintenance system**

Maintenance Plans Available	Y/N

Maintenance Mode Code	Extent			Responsibility of Maintenance with Resp. to Organization	Whether Budgeted
	Money	Labour	Hours		
*					

* Mode of maintenance - to be decided locally

Maintenance Code	Code
Hired labout	1
Group work	2
Assigned area	3
I	I

Institutionalizing Inventory and MIS of FMIS

The group suggested three basic considerations for institutionalizing inventory and MIS.

Firstly, the FMIS inventory and MIS should be based on the goals, objectives and plans of the FMIS. These goals, objectives and plans should be very clear to the FMIS.

Secondly, inventory and MIS are tools for management. It should not be treated as a tool to "audit" individual performance but rather as a feedback mechanism for improving performance. In turn however, managers of FMISs should be motivated to turn in better systems management. One source of such motivation is seeing action or "results" from the inventory undertaken or MIS installed.

Thirdly, the MIS framework development must be based on farmer's experience. Indicators used should be internally developed and not externally imposed. In cases when agencies need to derive information from the FMISs, farmers should be convinced of why they need to give out certain information or cooperate in data generation.

For the implementation phase or actual installation process of MIS, the following pointers were offered by the group:

1. There is a need to strengthen the water user association (WUA), specifically putting in place the structures necessary to implement the MIS. Moreover, there is a need to build up the capability and resources of the association to enable it to respond and act on decision arrived as a result of the MIS.

2. Information gathering is "bottom-up" with feedback mechanisms to lower levels of the organization. As could be gleaned form the data collection format suggested by the group, most information required would emanate from within the system, farmer members in particular. Laying out information system where farmers would be involved in information generation would be very ideal. However, channeling back to them the results is crucial to sustain their participation.

3. Although MIS and inventory process need to be internally developed and appreciated, the agency's role in putting shape into the MIS and conceptualizing its format should not be discounted totally. However, agency personnel assisting FMIS installation of MIS should be adequately trained and efficiently attuned to the "culture" of the FMIS. A very effective strategy used in the past is employing the help of experienced farmers in the installation of MIS in other MISs.