SPECIAL REPORT

INDONESIA MAKES THE TRANSITION TO O&M

John Colmey in cooperation with Hammond Murray-Rust and Douglas Vermillion

The development of infrastructure to exploit the potential of water resources has been a recurring theme in Indonesia's past four national plans. By the end of the fourth national plan in 1989, the Government of Indonesia will have invested, with foreign assistance, over US$12 billion in the construction, rehabilitation, and upgrading of irrigation systems.

Between the years 1969 and 1978, priority was given to construction and rehabilitation of dams and weirs, diversion structures, and primary and secondary canals, mainly in Java. In the 1970s major investments were made in new schemes and increased emphasis was given to tertiary development in the upgrading of small systems. Total public irrigated area now stands at 4.3 million hectares (ha), the largest agency-controlled irrigated area in any southeast Asian nation.

The development of water resources has been closely linked to agricultural intensification policies, which have had as their principal objective self-sufficiency in rice, the staple food of Indonesia's 170 million people. That goal was achieved for the first time in 1985. Productivity increases as high as five percent per year have been achieved through new rice varieties, greater use of inputs, and extending or upgrading irrigation systems.

To maintain self-sufficiency, rice production must increase at about three percent per year. Assuming that the bulk of the breakthrough in new rice technologies has been achieved, and that most of the irrigated area in Java (where more than two-thirds of the population lives) has already been developed, future production targets will have to be met through improved performance of existing irrigation resources. Moreover, if agriculture is to continue to contribute to the economy, Indonesia must fully exploit the potential for irrigating more profitable non-rice crops in the dry season.

The rate of increase in rice production is currently declining. A recent statement by Ir. Radinal Mochtar, Minister of Public Works, stresses the need to focus on improved operation and maintenance (O&M) to maintain rice production increases and arrest deterioration of existing irrigation systems that result from difficulties faced by provincial irrigation services (PRIS) in operating and maintaining relatively sophisticated facilities. The government must create the correct environment for adequate funding and staff support for O&M activities.

Like many Asian countries, Indonesia faces a dilemma over where these funds will come from. Unlike capital investments, which attract large amounts of donor funding, O&M costs come out of recurrent budgets from which donors shy away. Indonesia has been particularly hard hit by the drop in oil prices, forcing the Central Government to make a 50 percent cut in funding for irrigation O&M.

NEW POLICY ON O&M

The government's recent statement of policy for the irrigation sector is directed at improving O&M performance while at the same time moving the irrigation sector towards a self-sustaining future. In effect, the policy marks a turning point in Indonesia's irrigation sector from a construction-oriented perspective to a management-oriented perspective.

The policies call for transferring all responsibility for funding O&M in large systems to the PRIS and the complete responsibility for O&M in small irrigation systems (less than 500 ha) from the PRIS to water user associations (WUAs) over 15 years. The government will then encourage per hectare increases in O&M funding by PRIS to meet the actual needs of larger agency-managed irrigation systems, and to assist in strengthening irrigation institutions for the changes. Eventually the PRIS and the WUAs will be expected to finance all costs through the implementation of a new irrigation service fee (ISF).

To assist the government in meeting the current shortfall in funding, and in making the transition in general, the World Bank and the Asian Development Bank (ADB) recently approved irrigation sector loans to Indonesia of US$240 and 150 million, respectively. Both loans have as their objective more efficient O&M. At the end of five years, the government is expected to achieve its goal of financial self-sufficiency. Both loans include parallel components for the development of efficient O&M procedures, O&M needs-based budgeting (as opposed to area-based), introduction of the ISF, support for turning over small irrigation systems to WUAs, and institutional strengthening of irrigation agencies and WUAs.

Indonesia is re-evaluating its approach to O&M, like many Asian countries, to stop the deterioration of existng systems.

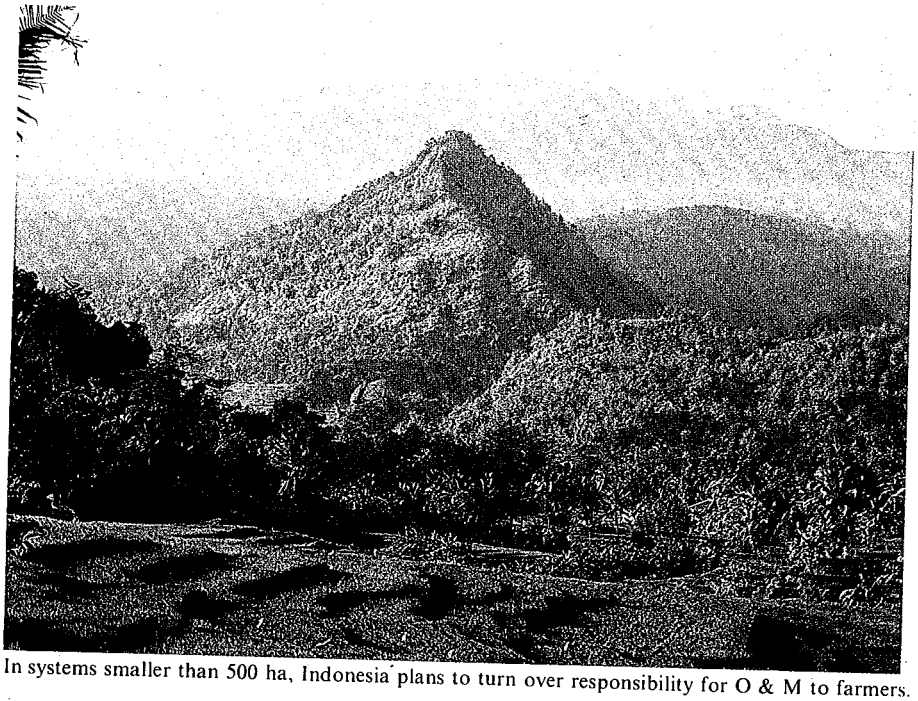
IIMI'S ROLE IN INDONESIA

As in other IIMI programs now underway in Nepal, Pakistan, the Philippines, and Sri Lanka, Indonesia staff collaborate closely with the national irrigation agencies and other institutions in action research and development on issues specific to the country's needs. Results generated in these programs are quickly disseminated to other countries where similar issues are important.

In Indonesia, IIMI has two internationally recruited staff, Dr. Hammond Murray-Rust, an agricultural engineer based in Jakarta, who moved from IIMI's Pakistan program to replace Dr. Sam H. Johnson III, and Dr. Douglas Vermillion, a social scientist based in IIMI's Bandung, West Java office, who has been with the program since its inception. Most of Indonesia field research staff have been seconded to IIMI from the PRIS where IIMI's sites are located. Two social scientists from Andalas University in Padang and Padjadjaran University in Bandung have been recruited near full-time to work on the turnover program. The Department of Agricultural Engineering of the Gadjah Mada University has been subcontracted to collaborate with IIMI on its research on agency system management in the Cikeusik and Cisanggarung areas.

IIMI began work in Indonesia in 1985 in response to a request from the government and the ADB to take part in a study with the International Food Policy Research Institute (IFPRI) aimed at improving irrigation management performance generally, and more specifically, adapting management to support dry season crop diversification in systems originally designed to irrigate rice. IIMI's program now underway in Indonesia has two components which support the government's current policy and strategies, as well as those of the two sector loans: 1) irrigation system management for "large" technical systems (over 500 ha) and 2) turnover of small systems to farmers.

Under Phase II, due to be completed in 1989, supported by the ADB and Ford Foundation, IIMI, together with the Directorate of Irrigation and the related PRIS, is identifying and testing a number of practical procedures to improve management in PRIS agency systems in West Java and Lampung, Sumatra. In the system turnover program, IIMI has field staff in three irrigation sections, Sumedang and Kuningan in West Java, and Solok in West Sumatra. Both of these provinces have been selected by the government as pilot learning areas for the turnover program.



In systems smaller than 500 ha, Indonesia plans to turn over responsibility for O & M to farmers.

MANAGING AGENCY SYSTEMS

As in many countries, Indonesia has a formal set of rules for allocating and distributing water in agency systems. In Indonesia, they require an accurate assessment of the current demand every 10 or 15 days (depending on the province), which means determining the total cropping area and the type of crops. This becomes increasingly difficult in the dry season when farmers cultivate a mix of rice and non-rice crops, which requires an even more precise knowledge of crop areas, growth stages, and water demands. Indonesia's PRIS must manage irrigation systems in an environment of fragmented landholdings, variable cropping patterns, micro-level diversity in soils and landforms, and often considerable hydrological interconnections of systems.

"Field assessment of demand," says Murray-Rust, "is built up to make a total demand for the system, allowing for estimates of conveyance losses and other factors. Total demand is compared with supply, and the resulting ratio (factor K) is used to make operational decisions. With plentiful water, the system is run with continuous flows. If there is need for rotations, it generally begins at the tertiary level, where farmers rotate water among themselves. As supplies decrease further, the government begins to implement rotations among tertiary blocks, eventually among secondary canals, and perhaps between weirs along a rivercourse."

"We found two major constraints to this management system," says Murray-Rust. "First, estimates of the actual areas under different crop types are usually based on reports to the field irrigation officer from the village water master *(ulu-ulu)*. These are usually rough estimates as there are no adjustments for soil variation, and official records of block sizes are often inaccurate."

On the supply side, the prevalence of inoperative division structures, inability to measure water, and sediment buildup further complicate the planning. "Because most of the systems are of the run-of-the-river type," notes Murray-Rust, "sediment buildup is high. Also some systems often run at as low as 50 percent of design discharge. This can be as big a factor in performance as the difficulty in measuring demand. The agency does not have the staff or the funding to adequately maintain all its systems by itself." In systems examined by IIMI, which were considered to be above average, between 30 and 70 percent of main system measuring structures were operating.

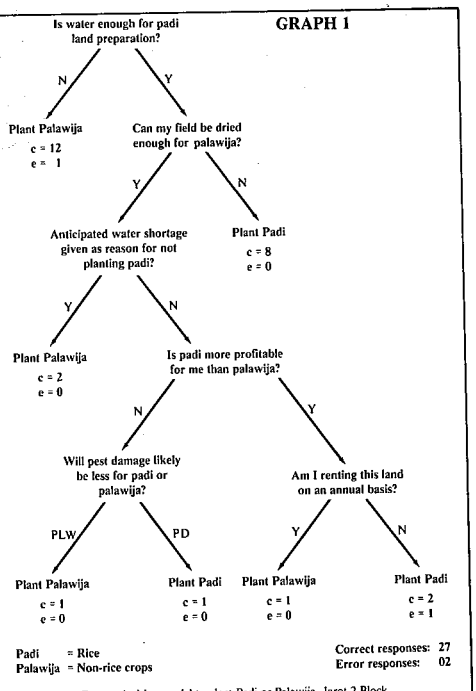
"Second, we found big differences between planned and actual discharges. As a result, some blocks receive much more water, others much less, than planned," says Murray-Rust. "On the demand side, the system usually doesn't cope well with soil variations, variable conveyance losses, inaccurate block sizes, and high variation between small landholdings in crop types with different water demands. On the supply side, additional water supplies from other canals, village weirs, drains, or conjunctive groundwater use are not included in calculations," Vermillion points out.

"Some areas IIMI observed in Phase I, for example, were getting as much as six times their planned discharge, others less than half. In the dry season, supply in the main canals, rather than being constant as assumed by the current management system, is often rotated or fluctuates widely. These effects become greater as water moves down the system," adds Murray-Rust.

The IIMI Phase I study helped clarify the high intensity of information staff and funds needed to implement properly the factor K system. The management requirements to collect the demand and supply data, to assess the demand every 15 days, and to adjust the gates in response to frequent discharge fluctuations tend to overwhelm general management capabilities. During Phase I, IIMI identified key weaknesses in field implementation of the current management systems in use in East, Central, and West Java, with particular regard to the information base and system operation practices.

IIMI also tested and recommended several new procedures to improve the information needed for management decisions. This included the use of a new pocket-size book by the gate operator to record discharges, the use of the management performance ratio to monitor and respond to variations in planned and actual discharges, and the making and using of tertiary block maps to improve information on actual crop areas. "We also interviewed farmers about their crop planting choices," says Vermillion, "and found farm-level water shortage or excess to be the most important factor across all sites in determining whether or not farmers will plant a non-rice crop in the dry season" (see Graph 1).

GRAPH 1



Farmer decision model to plant Padi or Palawija, Jarot 2 Block, Central Java, first planting period of 1986 dry season (Gadu 1).

Vermillion says that in Phase II, "IIMI is not concerned with diagnosing management constraints and problems, but with identifying and testing new procedures to strengthen the information base and rationalize management decisions. PRIS and IIMI are involved in deciding which aspects of management performance should be improved through intensifying management capabilities and which should be improved through simplification." As Murray-Rust puts it, "The existing management system is technically quite sound, but is often beyond the capacity of the agency. In the same way, I think the systems are over-designed. Many were designed or rehabilitated in the capital intensive 1970s when a measured management down to the field level was assumed."

Under the agency-managed systems research, IIMI staff have been posted in the Cikeusik system, Cisanggarung river basin, and Ciwaringin system near Cirebon, West Java, and in the Way Jepara Irrigation Project in Lampung province in southern Sumatra.

Cikeusik System and the Cisanggarung River

At 7,500 ha, the Cikeusik irrigation system is the largest system currently under study. It is the last of seven relatively large systems (and numerous smaller systems) along the 60 kilometer long Cisanggarung River, which flows northward into the Java Sea. Cikeusik is a good example of irrigation under diverse cropping conditions. During the wet season it irrigates rice, sugarcane, and even some non-rice seasonal crops. During the dry season there is less rice, a fairly constant level of sugarcane, and about one-third of the area in non-rice crops. The mix of crops, occasional severe water shortage, and the location on the river leads to an intensive management requirement, under diversified cropping conditions.

Despite its unfavorable location on the river, the system maintains high cropping intensity throughout the year. "Part of the reason," says Murray-Rust, "is that farmers use a considerable amount of groundwater in the lower part of the system, to irrigate non-rice crops."

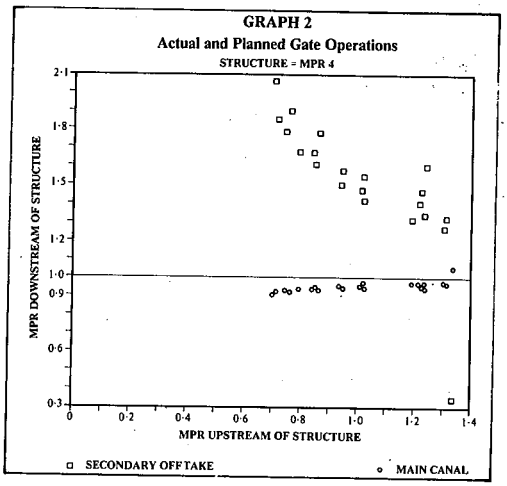
According to Murray-Rust, IIMI has an opportunity to study three main areas. "The first is system operation, how you manage a system that becomes increasingly short of water as the season progresses. This includes improving procedures such as adjusting gates in response to fluctuation, efficient rotational arrangements, and

establishing proper planned discharges. The second is conjunctive use, how farmers cope with water shortage by tapping groundwater, either by hand or by pump. And third is the intensity of diversified crops. Cikeusik has large areas under onions, chilies, and various types of beans. Onions and chilies can be very profitable. Many farmers, for example, have found it worthwhile to grow only onion in some fields throughout the year, and can get as many as five crops per year, despite the heavy labor requirement, including manual irrigation."

"We are measuring planned and actual discharges and gate adjustment practices at 54 gates in the system," Vermillion says, "at main, secondary, and tertiary levels. We interview gate tenders and irrigation officers each week about their rationale for adjusting gates as they have. This information, together with data observations on actual gate adjustment practices, gives us a perspective on the real logic of management responses."

For example, as Murray-Rust points out, gate tenders generally favor their areas at the expense of downstream farmers. Graph 2 (Actual and Planned Gate Operations) demonstrates the practices of a gate tender at a secondary offtake in the upper part of the main canal during April 1988. The Y-axis is the ratio of actual to planned discharge, with the horizontal line at 1.0 indicating the optimal management performance ratio (MPR). The X-axis is the ratio of planned and actual discharge arriving at the division structure. The small squares show that the local gate operator gives more water than planned to his secondary canal, and less than planned to the downstream section of the main canal. Only when incoming discharge is at least 20 percent greater than planned will downstream areas receive close to planned discharge.

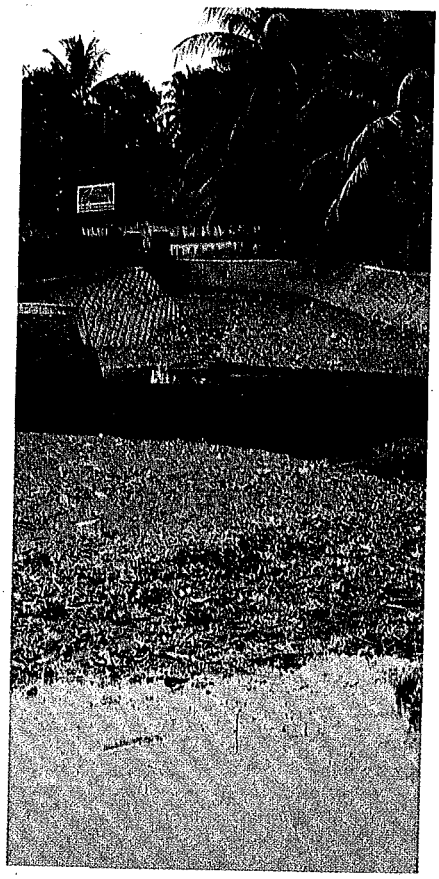
Because of the frequency of severe dry season water shortages, main system rotations are generally implemented by the middle of the first dry season. "Through repeating inspections of sample tertiary blocks we are uncovering the actual rules and



practices farmers use to distribute water at the tertiary level in response to changing main system conditions. This is important in a period where the agency is questioning the potential of farmers for increasing main system roles. Our weekly day and nighttime main system inspections are clarifying the structure and extent of divergence between plan and practice," says Vermillion.

This year, the transition from wet to dry season was very abrupt. "The system went from having rotations within some tertiary blocks, usually below 100 ha in size, to rotations between secondaries serving from 2,000 to 3,000 ha each in less than two weeks. When the rains suddenly stopped, the river discharge into the system dropped by almost 75 percent," says Murray-Rust.

IIMI has begun to collect and analyze data on water supplies and demand for, and operation of, the Waduk Darma reservoir and seven systems along the Cisanggarung rivercourse (of which Cikeusik is the last weir). The purpose is two fold. First, IIMI would like to help to improve forecasting of water supply and water availability along the rivercourse and into the systems, on the basis of historical and immediate data on rainfall and stream flows. Second, we are attempting to develop a standard, rationalized contingency management system for adjusting the reservoir outlet and weir intakes in response to fluctuating water supplies. Along the river, some upper-end systems get three rice crops a year



Although Indonesia has sophisticated irrigation systems, the difficulty has been in mobilizing the resources necessary.

while others have only one or two crops and some fallow lands. Some annual cropping intensities exceed 275 percent, while others are below 200 percent.

IIMI's activities in Cikeusik and along the Cisanggarung River are being undertaken with cooperation not only of PRIS but also the Provincial Agricultural Service, the International Rice Research Institute (IRRI) in the Philippines, the University of Gadjah Mada, Sukamandi Research Station, and the Soils Research Institute with additional funding provided by the Rockefeller Foundation.

Ciwaringin System, West Java

Typical of Java, the 2,420 ha Ciwaringin irrigation system is a run-of-the-river system in a network of interconnected irrigation systems that pick up drainage water from small weirs, suppletion canals from other systems, and residual flows out of the rivers. Despite water shortages in the dry season farmers tend to either plant

rice or leave the land fallow. There are extreme discharge fluctuations in the main canals because the system utilizes more than one river, unlike Cikeusik. "The number of intakes makes for a completely different set of management activities from that in a system like Cikeusik which has a centralized water source," says Murray-Rust.

"There is a need to make official distinctions between different management systems, which would be seen as contingencies arising from variable levels of management sophistication and measurability relative to local needs and capacities. In fact we have seen that only a minority of PRIS systems actually attempt to implement the factor K management system," notes Vermillion. Ciwaringin is a clear case where local adjustments need to be made in the management system due to the extent of unmeasured supplementations at all levels, substantial spatial variations in percolation and seepage rates, and frequent inaccurate or out-of-date block area figures.

In Ciwaringin, water begins to get scarce early in the dry season, often dropping to one-third of the requirement before risk status develops by mid season. Farmers in the lower half of the system avoid the risk of planting any irrigated crops in the second dry season, partly because of scarce water being used in the upper area in continuing cultivation and partly because of severe rat infestation in the lower area.

In both these systems, IIMI is taking a wide range of climatic readings, such as rainfall and evapotranspiration rates, to assess better what the actual demand is as opposed to the estimated demand. Public agencies use a formula to assess the estimated demand based on an assumption of crop water requirements. "We are going to see how close the estimated demand is to the real situation in the field," says Murray-Rust. "Our readings tend to show much greater variability, because government estimates tend to be averaged at the section level. System specific management approaches will improve management performance in both systems. If they begin to move in that direction we can assist in developing a process which takes into account questions such as local actual and probable rainfall, likely evapotranspiration, or the likely contribution of groundwater. Only then can a system be managed truly according to location-specific information, rather than using general administrative guidelines from above.

"However much we may attempt to quantitatively account for all the demand and supply-related factors, in the end the fact remains that irrigation is not only a science but is also an art, requiring some scope for official agency accommodation for qualitative judgement, negotiated adjustments, and experience-based decision making," says Vermillion. The crux is how to balance measurable accountability with qualitative flexibility. PRIS field operations staff often of necessity exercise well-intended initiative given local complexities. And yet since this cannot be incorporated into the present official management system, staff are often discouraged from reporting actual conditions and practices in a way which could enable performance to be monitored, and hence, improved."

IIMI is now moving towards a more regional examination of management practices and the potential for improved performance. Murray-Rust notes that "We had to start with more specific system studies to gain an understanding of what is a very complicated management system. However, we do not have the staff or the resources to look at many systems in this kind of detail. Also as IIMI tests and recommends new procedures to the government, they have to be generic enough for them to apply over a range of systems." IIMI has begun this year examining water management of a reservoir and multiple weirs along the Cisanggarung River. IIMI will also soon assign staff to monitor implementation of new O&M procedures in several of the pilot "advanced operations units" of PRIS subsections in West Java in conjunction with the West Java Irrigation Project.

Collaboration plays a central role in IIMI's Indonesia program. System engineers and officials allow IIMI to research existing systems, and provide IIMI with valuable insights and feedback on research.

Way Jepara, Lampung Province, Sumatra

In 1987, the Directorate of Irrigation asked IIMI to expand its research outside Java to field test innovations under different physical and management conditions. The

government feels a strong need to increase dramatically the management performance and hence productivity of irrigation systems in such provinces as Lampung, where the government has invested heavily in constructing new systems during the 1960s and 1970s.

Way Jepara is part of a transmigration resettlement project, with the first major inflow of migrants coming from Java and Bali in the late 1950s and early 1960s. Each family received about two hectares each and subsisted on rain-fed agriculture until the government decided to develop the project for irrigation in the 1970s.

The Way Jepara irrigation project was built in 1976. Originally designed to irrigate 6,650 ha, the current irrigated area is about 4,700 ha, and is still being extended. Although it is only 12 years old, the system is already in need of rehabilitation.

"Although we have only been in Lampung for a short time," says Murray-Rust, "it is already clear that there are a number of ways in which management efficiency can be improved. The reservoir spills every year, which suggests that it does not have enough capacity to meet the potential demand once the system is fully developed. During the wet season the agency rarely shuts off the reservoir, which allows the reservoir level to drop a little earlier than necessary at the end of the rains. This suggests there are opportunities for managing the reservoir to maximize the amount of stored water for the dry season."

There also appears to be significant opportunity for increasing dry season production during high rainfall years. "The allocation of rice is almost the same every dry season. The top half of the system is allocated rice one year, and the bottom half the next year. So this year, for example, the rains extended for two extra months, and yet we have a peculiar situation where the upper half of the system is not being irrigated, and the lower half has more water than it can use. There is virtually no rice being grown in the upper half of the system. They underestimated the amount of rice that could be irrigated, though eventually they did allow more rice to be grown."

There is also a peculiar weed problem. The reservoir traps the sediment, so that clear water allows weeds to grow and reduce flow by as much as 50 percent. It is a system where farmers play a significant role in maintenance of the main canal. Three or four times each year 200-300 farmers assist the PRIS in cutting the weeds. "This is an example where farmers are willing to assist the agency because they know it would not be able to maintain the canal by itself given its current staff and funding levels," says Murray-Rust.

As a transmigrant system, Way Jepara offers IIMI the opportunity to investigate various organizational aspects of the system. Farmers in the system come from different areas including Bali, and East, West, and Central Java. They bring their own rules and procedures for how to manage water at tertiary level.

"Balinese villagers," says Murray-Rust, "allocate water proportionately with a continuous flow of water into everybody's field based on area. In Javanese villages, it is more common for one person to receive all the water until his field is full. The Balinese approach requires less labor, whereas the Javanese approach requires someone to be in the fields all the time while diverting water into a set of fields. One sees some interesting differences within a single system because of the different backgrounds of the people."

"In general, we feel that the opportunities for improving water use in Way Jepara are quite high. The annual crop planning process imposes a simple but rigid plan at a high level, inhibiting the opportunity for making short-term management decisions. Once you've decided to split the system into two halves (one half receiving water for a season and the other half not), you leave little room for flexibility. It may be necessary to determine a way of finding a minimum irrigable area, but allowing for upward adjustments according to what the hydraulic conditions become. If there is more water than normal in the reservoir you could then devise a system for giving water to some of the farmers in the unirrigated half of the system.

TURNING OVER SMALL SYSTEMS

As part of the turnover component of the new irrigation sector loans, the government has agreed to transfer small systems (at first those less than 150 ha) serving a total of 20,400 ha to WUAs within the first 3 years, and to begin, in the third year, to prepare for transferring an additional area of 48,000 ha. After 5 years, the transfer of systems between 150 and 500 ha will begin. After 15 years 70 percent of all systems currently in the government's inventory, totalling some 899,599 ha or 21 percent of the total government irrigated area, will be turned over to WUAs.

Many farmers find it worthwhile to grow onion year round, with some growing as many as five crops annually.

"By turning over responsibility for O&M to farmers (and perhaps eventually system assets as well)," says Vermillion, "the government hopes to reduce its administrative burden and free additional resources for use on larger, more technical irrigation systems. Reallocating funds and staff from smaller to larger systems will also help the government in meeting the O&M funding target of Rp 23,500/ha (US$14) for agency systems."

The government is implementing the turnover program first in West Java and West Sumatra because of the large number of small systems in these mountainous provinces. IIMI has staff in three sections in the pilot provinces, in Sumedang and Kuningan sections in West Java and in the Solok section in West Sumatra.

IIMI's research is designed to produce prompt information, analysis, and frequent suggestions aimed at improving the turnover process, as it is being implemented in pilot areas, so that the pilot stage will be as much a learning process as possible in the emergence of a national program. IIMI is examining the implications of turnover for the PRIS budgets and staff allocation and new PRIS and farmer management roles.

IIMI has been collecting data on PRIS investment patterns in staff, routine O&M funds, and construction, in large and small systems in each section (with over 70 systems per section). This will help clarify both the levels of current farmer dependency on the agency as well as the likely scope for real government savings due to turnover. Preliminary findings indicate that smaller systems have already been getting much lower levels of investment per hectare than larger systems. IIMI is also beginning to examine patterns of farmer investment in selected systems and to monitor management performance in eight systems in Sumedang and Solok sections before, during, and after turnover. This will help address the concerns about how capable farmers are of operating and sustaining small systems.

Turnover is not simply PRIS in retreat but an effort to reorient responsibilities with capabilities. PRIS will move away from O&M within small systems and focus on coordination of water allocation between systems, strengthening of water user associations, and providing longer term, low-level service to systems. The aim is an optimal mix of government and WUA investment which takes full advantage of farmer capacities.

Irrigation officials are now being asked to document O & M activities. Here, a field manager photographs weeding.

The Ford Foundation is funding both IIMI and LP3ES (Institute for Socioeconomic Research, Education, and Extension), a local non-governmental organization (NGO), to assist in turnover. LP3ES is responsible for training, program development, and field advisory support. The Ford Foundation, through Dr. Frances Korten, has encouraged the formation of a national-level working group to discuss turnout planning and issues. The groups consist of national and provincial level irrigation officials, the Ford Foundation, LP3ES, and IIMI. IIMI has participated in this working group since February 1987 and is now closely interacting with PRIS officials as the turnover process unfolds in the pilot provinces.

The first stage in the turnover sequence is a regional rivercourse inventory of small systems (conducted by PRIS staff after being trained). This is done to determine the level of past and current PRIS investment in systems. The inventory distinguishes between three types of systems. First are those systems which have never received government investment and simply should be reclassified as non-PRIS systems. (Some sections have incorporated systems into the PRIS without any PRIS investment. Budgets are based on area irrigated by sections.) The second type are those systems that do not need any physical repairs, but only require a change in management roles, or a strengthening of the WUAs. Third are those systems that require both repairs of physical structures and a change in rules for the WUAs. Those systems that received government assistance, and therefore may have become dependent on PRIS investment, are then brought to the next stage in the process, the socio-technical profile.

The profile is an information gathering method, first developed in the Philippines, to determine the farmers' existing organizational structure and practices, the division of responsibility for O&M between the farmers and government, the location of functional or faulty structures, and the cropping patterns. This provides a basis for planning what needs to be done in a system prior to turnover. The survey is currently completed by lower level government officials, called "TP4." The TP4 are trained to act roughly like a community organizer for WUAs. Significantly, inside this acronym is the phrase "farmer water managers," used by the government, rather than the more passive, conventional term, "water users," Vermillion points out.

In the third stage, the TP4 works with the farmers to design and plan the construction or rehabilitation of new or existing structures, and the

development of the WUAs. The government has created a special maintenance fund that will provide about US$90/ha in improvements. The total turnover preparation time expected for most systems is about 15-18 months.

Sumedang Section, West Java

Cinnangka 2 is a small irrigation system in a hilly upland area, typical of systems in the Sumedang section, just west of Bandung, the provincial capital of West Java. The command area is 104 ha, most of which is planted to rice twice a year. Originally built by the farmers with temporary brush stone weirs, it received intermittent assistance through a government subsidy program to aid villages. In the late 1970s, as part of the Sederhana irrigation project, the government built a dam at the intake to the system to supplement water to the lower section and then reclassified it as an agency system. Now the system has six PRIS gate and channel tenders helping to cut weeds in the channels and operate main offtake gates. These roles will be transferred to farmers after turnover.

The system includes two villages. During dry season rotations, the upper village receives water during the day and the lower village receives water during the night, with subunits receiving flows on different days or nights. The village-based WUAs organize and police the rotations, not the agency staff, and also mobilize farmers for heavier maintenance activities, such as de-silting channels four or five times a year.

IIMI's first activities in the section have been to collect data on PRIS and farmer investment in several systems and to observe and document the inventory and profile activities in sample systems. "We evaluated," says Vermillion, "how well the TP4s understood their tasks, how they interacted with farmers, the adequacy of their information sources, and how well they met their objectives."

"We are recommending," he continues, "that the profile be extended from the current 10-15 days, to about a two month period in order to include directly, completion of a farmer version of a design for system improvement, as well as the farmers' own plan for their investment in the improvements, before the technical design people arrive on the scene. This would also include a plan to develop new WUA management roles relative to the new investment and advent of turnover. We think it is crucial that the farmers make some group investment in the system prior to turnover, both in order to strengthen their sense of ownership and to provide a 'physical event' as a basis for organizing. It is also important that the farmer-designed version precedes preparation of the 'technical' design so that the former will be the basis for the latter, rather than the reverse."

Kuningan Section, West Java

Another system, Cinnangka, in the Kuningan section has been selected as a pilot system for the larger class of system turnovers. Its command area is 441 ha. The system has evolved over time, through various rehabilitation projects both by farmers and the government. At first, in known history, was the brush and stone weir at the top of the system. It was later replaced by a slightly more sophisticated weir, and later by yet another weir. The farmers built a 1-1.5 meter high masonry retaining wall 800 meters long. The first three weirs were built by the farmers. The government built the last one in 1980, which is about 50 meters across and 7 meters high. There are two other stone-and-earth suppletion weirs built by farmers for the lower part of the system, requiring heavy yearly farmer labor inputs.

"This system is an example," says Murray-Rust, "of how the irrigation development process tends to move from a low-capital-cost/high-maintenance-cost system to a high-capital-cost/low- maintenance-cost system. The system has had very high levels of both farmer and government investment, the latter providing lined channels, measuring structures, and sliding metal gates." Vermillion adds, "That's what makes it such an interesting, and problematic, pilot test case for the larger class of systems being turned over. As part of the turnover, the agency plans to form a WUA that will cut across the seven villages served by the system. There already is an embryo inter-village WUA which meets regularly with representatives from different villages. However, its management requirements might be expected to climb significantly after turnover."

"The implications of transferring systems of this size," says Vermillion, "are much more pronounced than the smaller class -- the structures are much bigger, use permanent materials, are more technical and difficult to operate, and involve more farmers living in several villages."

Solok Section, West Sumatra

The Pauk system is about a two-hour ascending drive inland from Padang, the provincial capital on the coast of West Sumatra. It is in a mountainous area and irrigates rice year-round. The system has received minor investment from the government to build reinforcing walls along some of the channels. In contrast to the Cinnangka 2 system in Sumedang, there seems to be an absence of farmer organization, a case of a WUA that "doesn't function." The channels are overgrown with weeds and are filled with sediment. "The reason for this deterioration," says Helmi, IIMI field coordinator, "is that farmers have more than enough water."

"Because there is water throughout the year, farmers tend to plant their rice crop at different times of the year, and use different varieties, in accordance with their money flows. If there is a landslide or collapsed embankment which obstructs channel flow, those farmers who need water at that particular time have an incentive to participate in the maintenance activity, while others who may be harvesting do not. Farmers near the head of the system rarely have an incentive to get involved. Any organization or resource mobilization is strictly event-specific," he continues.

The Bunian system takes water from the same river, immediately adjacent to the Pauk system. But Bunian has

received considerable PRIS investment, including a cement weir, lined channels, and steel gates. Despite the added investment, the system is in much the same condition as Pauk. The channels have heavy sedimentation and the gates are locked in place by rust, so that the system always runs on continuous flow. Farmers seem to be responding to a situation of water abundance and (at least in the case of Bunian) of expectations of the possibility of government assistance should the system deteriorate too far.

According to Vermillion, "There is a tendency in the mountainous areas of West Sumatra as well as West Java, for the agency to bring a lowland, large system orientation into investing in small, hilly systems -- namely, an emphasis on diversion and division structures. Whereas farmers tend to emphasize investment in conveyance - which is much more problematic in hilly, relatively water abundant areas than water acquisition and divisioning. Also farmers tend to make structures with low intensity management requirements. One example is farmer-built flood/silt control walls, built over the top of the canal just below the offtake to divert flood water back into the river automatically, rather than having an adjustable overflow gate which requires someone to adjust a gate on short notice to avert flooding, structural damage, and heavy siltation.

"It is essential," he continues, "that farmers play the key role in designing pre-turnover improvements not only to instill a sense of local responsibility and facilitate formation of a vibrant WUA, but also to ensure the appropriate design of structures for which farmers are capable of managing and sustaining."

"For PRIS, turnover will mean first a significant amount of staff and resource reallocation and training," says Vermillion. "Under different conditions PRIS staff may be either moved to larger systems, simply released, given a more macro-level assignment, become part of a mobile, incidental maintenance service team, or perhaps stay put but be paid by the WUA instead of PRIS. Reassessments of actual staffing requirements in larger systems need to be made."

"Second, there will be a change in the role of irrigation officers from an intra-system role to a macro inter-system role with responsibilities for coordinating and supervising rivercourse water distribution. Third, the turnover program invokes a reorientation of the PRIS towards providing incidental assistance to systems after turnover. This must be done in a way that does not replace local farmer resources but discriminates between repairs that can be handled locally and those which require joint agency/farmer investment. Fourth, the PRIS will need to set up a needs-based budgeting system which incorporates the emerging incidental or indirect costs which will characterize the post-turnover orientation, whereas the current budgeting structure is based on a direct investment orientation towards O&M.

THE CHALLENGE: TRANSITION TO AN O&M FOCUS

The Indonesian irrigation sector is in a fascinating but critical stage of transition. Current policy is to achieve self-sustainability in irrigation O&M by reducing expenditures, either directly or through subsidies, and by introducing fees for irrigation services. Without adequate financing, the irrigation systems will deteriorate, which will make it more difficult to sustain and increase food production. And there will be fewer loans available for rehabilitation of these systems in the future.

"But Indonesia faces more than a budget challenge," says Murray-Rust. "Indonesia has to continue to manage water in a way that maximizes its productive value. Water resources are becoming increasingly scarce. There are more people, there is more urban and industrial demand for water, particularly in Java. Irrigated agriculture has to become more efficient. So the government has the task of not only finding the money to run the systems, but it has to develop the methods to run them cost-effectively."

"Getting a steady increase in production of two or three percent a year through management improvements is not going to be easy. Some of that increase has to come through greater diversified cropping, because of the lower water requirement. But that will be limited, as rice will have to remain the priority."

"By looking at the management requirements of a system," says Vermillion, "you can begin to see what the government will need to do in terms of technical change, redeployment and retraining of staff, and new procedures -- all of which would help to make those systems more productive. It will need to develop more precise records of water supply conditions, and season by season plans which are more responsive to the actual, variable conditions."

"To do this the government requires information and analysis of how to realize its policies through improved management, which our research is aimed at providing. Like most irrigation agencies, the government agency does not have a research branch. IIMI's role," concludes Murray-Rust, "is to work closely with the agency to fill that gap."

There are few illusions that the transition towards O&M will be rapid. Ir. Winarno Tjiptorahardjo, Head of Irrigation O&M in Indonesia and Ir. Soekarso Djunaedi, Head of Irrigation Tertiary Development, agree that it will take several years for the agency to move from a design and construction orientation to a self-sustaining management orientation. However, he is confident that this will be achieved through the recently revised policy for the irrigation sector that emphasizes self-sustained O&M funding and more site-specific management roles for the Provincial Irrigation Services.□