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THE HIGH PERFORMANCE SEDERHANA IRRIGATION SYSTEMS PROJECT

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Pengelolaan Air Tingkat Usaha Tani Teladan (HPSIS)

oleh

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Disamping mengembangkan dan mengelola sistim pengairan skala kecil, proyek HPSIS juga memungkinkan adanya perkenalan, percobaan, dan penyempurnaan pendekatan untuk keikut-sertaan dalam proyek-proyek pembangunan. Dalam pendekatan ini, para petani akan terlibat dalam pengambilan keputusan dan kegiatan-kegiatan yang biasanya menjadi tanggung jawab pemerintah Indonesia atau para kontraktor.

Sebagai dasar penelitian dipergunakan "model PID" (participatory irrigation development) yang menguraikan hubungan-hubungan yang seharusnya ada dalam proyek pengairan yang bersifat mengikut-sertakan. Model ini berusaha untuk mengukur besarnya manfaat yang diharapkan dengan adanya peningkatan keikut-sertaan para petani dalam proyek-proyek tersebut, terutama dari segi perubahan-perubahan fisik pada lokasi proyek dan perubahan-perubahan dalam pembagian air.

Kesimpulan menyeluruh yang diambil ialah bahwa HPSIS telah berhasil memperkenalkan keikut-sertaan petani di dalam pengembangan sistim pengairan pemerintah skala kecil di Indonesia. Hal ini terbukti dengan adanya beberapa tingkat keikut-sertaan petani.

Pertama, para petani telah berhasil merundingkan perubahan-perubahan dalam rencana yang penting dengan Departemen Pekerjaan Umum dan mendirikan atau membangun kembali bagian-bagian dari sistim pengairan itu sendiri. Ini menumbuhkan kepercayaan para petani untuk mengemukakan pendapat-pendapat mereka kepada pemerintah dan mengakibatkan pemerintah menerima pendapat mereka dengan sungguh-sungguh. Kedua, ketika para petani secara aktif mengambil bagian dalam perencanaan sistim dan pelaksanaan pembangunannya, biasanya diperoleh sistim pengairan yang jauh lebih baik, misalnya, jumlah sistim kanal utama dalam kondisi yang baik meningkat dari 38% pada awal proyek menjadi 85% pada waktu proyek selesai. Ketiga, proyek tersebut mengubah cara-cara pengambilan keputusan yang berhubungan dengan pengairan pada lokasi proyek, meningkatkan penyediaan informasi, sumber-sumber, dan peranan para petani. Keempat, proyek ini mengubah sikap para staf Departemen Pekerjaan Umum terhadap keikut-sertaan kaum petani: mereka lebih dapat menerima usul-usul para petani dan lebih mendorong semangat mereka dalam bertugas. Kelima, proyek tersebut memperbaiki hubungan dan kerja sama antara lembaga-lembaga yang bersangkutan di tingkat propinsi dan kabupaten. Keenam, sebagaimana telah makin sering sekali terjadi dalam proyek-proyek pembangunan yang bersifat pengikut-sertaan, sebuah organisasi non-pemerintah memiliki peranan yang penting dalam segi manajemen dan komunikasi dalam proyek HPSIS.

Ada beberapa catatan peringatan mengenai hasil dari penelitian tersebut. Nampaknya lebih mudah bagi para petani untuk mempengaruhi kwalitas fisik sistim pengairan daripada meningkatkan pembagian air, dan oleh karena penilaian terhadap keikut-sertaan petani dalam model PID terlampau berlebihan dengan adanya pengharapan untuk dapat menghasilkan manfaat yang terlalu banyak (misalnya dalam pembagian air dan peningkatan hasil pertanian), maka pengaruh dari meningkatnya partisipasi mungkin tidak begitu berarti seperti yang diharapkan semula. Bagaimanapun juga, jika partisipasi petani dianggap penting dalam pembangunan dan pemeliharaan sistim-sistim pengairan yang berjalan dengan baik, proyek tersebut dapat dikatakan sangat berhasil dan dapat menjadi dasar untuk menyempurnakan lebih lanjut peranan para pemakai air dalam pemilihan lokasi, perencanaan sistim dan pembangunannya.

Executive Summary

In addition to building and managing small-scale irrigation systems, the High Performance Sederhana Irrigation Systems Project (HPSIS) allowed for the introduction, testing, and refinement of a participatory approach to development projects. In this approach, farmers were involved in decisions and activities that are usually the responsibility of the Government of Indonesia or its contractors.

The basis for the project was the PID (participatory irrigation development) model which describes the linkages that are supposed to occur in participatory irrigation projects. The model sought to measure the benefits that are thought to result from increasing farmer participation in such projects, primarily in terms of physical changes at the sites and changes in water distribution.

The overall conclusion drawn from the project is that HPSIS has successfully introduced farmer participation in the development of pilot small-scale government irrigation systems in Indonesia. This is evidenced by several measures. First, farmers were able to negotiate several important design changes with the Ministry of Public Works (MPW) and constructed or rebuilt parts of the irrigation systems themselves. This gave farmers confidence in making their views known to the government and led the government to take the farmers' views more seriously. Second, when farmers actively participated in system design and construction, significantly better irrigation systems generally resulted; for example, the number of main system canals in good condition rose from 38 percent at the beginning of the project to 85 percent at the end. Third, the project changed the ways in which irrigation-related decisions are made at project sites by increasing information, resources, and the farmers' roles. Fourth, the project changed the attitude of MPW staff toward farmer participation: they became more receptive to farmers' suggestions and more encouraging about their role. Fifth, the project

improved relations and coordination among the Ministries of Agriculture, Public Works, and Home Affairs at the provincial and kabupaten levels. Sixth, as has been occurring increasingly in participatory development projects, a non-governmental organization had an essential management and communication role in HPSIS.

Some cautionary notes are given about the results of the project. For example, the results indicate that it was easier for farmers to affect the physical quality of the irrigation system than to improve water distribution. Because the PID model over-valued farmer participation by expecting it to produce too many benefits, e.g., water distribution and agricultural production increases, the effects of increased participation may not have been as significant as originally hoped. However, if farmer participation is considered to be important for establishing and maintaining good operational irrigation systems, the project was successful and provides a basis on which to further refine the role of water users in site selection, system design and construction.

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Preface

The Sederhana Assessment Study and the High Performance Sederhana Irrigation Systems Project represent two major evaluation efforts recently supported by the Water Resources Development Division of the Office of Agriculture and Rural Development, USAID/Indonesia. These studies examine two controversial aspects of small scale irrigation development: the effectiveness of rehabilitation on irrigation system performance and the contribution of farmer participation to irrigation system development. The methodologies of the two studies are unusual for Indonesia in their adaptation of engineering and other quantitative techniques to difficult field conditions.

The Sederhana Assessment Study (SAS) examines the impact of the rehabilitation of small scale irrigation systems. Intuitively, the concept of rehabilitation seems easier than designing wholly new systems. But does it make economic sense to rehabilitate systems which already irrigate hectarage, albeit inefficiently, when totally unirrigated land is available for development? SAS addresses this concern.

The High Performance Sederhana Irrigation Systems Project (HPSIS) treats a more elusive idea, that of "participatory" irrigation. More active involvement of beneficiaries (farmers) in the design and construction of government-financed irrigation systems is generally viewed as desirable. However, there are costs associated with beneficiary participation. The HPSIS project attempts to test and measure the effect of this participation in twenty-one irrigation systems which encouraged user involvement from the earliest stage.

On the surface, the two studies appear to present conflicting results. The HPSIS project finds that farmer participation can significantly improve the physical condition of the irrigation system.

However, the SAS study finds that, in general, the small-scale systems built by the Ministry of Public Works, without notable community participation, are in good repair and are functioning well.

But a closer reading, coupled perhaps with a greater familiarity with the two studies, suggests a different interpretation. SAS analyzed thirty irrigation systems. Although the "average" results are good, it should be noted that this mathematical average does not include data on four non-operational systems among those thirty. In addition, the "average" conceals a significant gap that exists between the cluster of good performing systems and the cluster of poor performing systems. If the problems encountered in the poor performers could be avoided in the future without a great deal of extra cost, the overall performance of small-scale systems could be improved significantly. An analysis of the system failures and of the below-average systems indicates that poor site selection was a major reason for poor performance. And site determination is an area in which greater farmer input (per HPSIS) could have alerted the system designers to potential problems, even before final design was undertaken.

USAID/Indonesia hopes that these two studies are useful contributions to the on-going research which will lead to the design improved irrigation systems.

1. INTRODUCTION

The purpose of the High Performance Sederhana Irrigation Systems project (HPSIS) was to build and manage small-scale irrigation systems (less than 2000 hectares) and to test and refine a participatory approach to developing and managing these systems. Because the participatory nature of HPSIS was felt to be "experimental" by the project designers (the Government of Indonesia, USAID and Ford Foundation), HPSIS was monitored extensively. This extensive monitoring enabled the provision of information on problems and the generation of a unique set of data on farmer participation and project performance. As a result, HPSIS provided a seldom-available opportunity to look critically and empirically at a particular application of participatory development, including changes in participation and their expected effects in a relatively large number of sites.

The first step in formulating this participatory process was to devise a way to get farmers involved in decisions and activities that were usually the responsibility of the Government of Indonesia (GOI) or its contractors. In early discussions and project planning, the participatory approach was considered an alien one, particularly by Ministry of Public Works officials, who felt that farmer involvement was of questionable value. Many of them knew of examples in Indonesia (the Balinese Subak) where farmers had been able to develop and manage their own irrigation systems, and some of them had been to the Philippines and had learned of the work done by the National Irrigation Administration. In general, however, the officials did not think that Indonesian farmers were interested or capable enough to negotiate with Public Works employees or contractors on system design.

The majority of Ministry officials believed that design was a matter for technically trained people and that farmers would only impede this process, in part because the farmers had individual needs and desires that were impossible to fulfill all at once, and in part because antipathy on the part of the farmers was anticipated. The most difficult obstacle to farmer participation was the idea that design could be negotiable, and that farmers might conveivably reject the recommendations of technical personnel.

The feasibility of HPSIS was also questioned because of the wide geographic spread of the project. In order to maintain a critical mass of interest, the HPSIS was carried out in 21 sites in 8 widely scattered provinces. This presented a logistical and administrative challenge.

Another cause for skepticism centered on a number of concerns over the mechanics of promoting farmer involvement at the HPSIS sites. The project approach was to rely on an as-yet untried technique in Indonesia: the use of specially-trained field workers called community organizers (COs). These COs were neither extension personnel nor technical people. Also, although the organization with primary responsibility for recruiting, training, and managing the COs had a fine record in community development, it had no previous experience with irrigation. Finally, it was not clear what the COs' relations would be with local government officials and political leaders once COs were in the field.

In spite of all these obstacles, the HPSIS was able to introduce this approach in Indonesia and involved farmers in irrigation-related decisions and activities that are usually the responsibility of the government. This was a significant accomplishment for the COs.

This paper begins with a description of the HPSIS project and participatory irrigation development. Then there is a summary of the main findings on the project's effects and policy implications for other irrigation projects. The appendices include a brief discussion of the HPSIS methodology and findings on the physical changes that occurred in the HPSIS irrigation systems and changes in water distribution during the project.

2. DESCRIPTION OF THE HPSIS PROJECT

2.1 HPSIS and the Sederhana Program

The HPSIS project was a component of the Sederhana Irrigation Program, which was begun in 1974 by the Government of Indonesia (GOI) with an initial investment of $31.7 million. The program's purpose was to increase food (primarily rice) production by building small, relatively inexpensive irrigation systems. The program's original target was to build or rehabilitate systems in 24 provinces on approximately 550,000 hectares of land. In 1974 the U.S. Agency for International Development (USAID) initiated support to the Sederhana Program with a loan of $20 million, which was increased to $23.7 million in 1976.

By 1978 approximately 240,000 hectares had been improved through Sederhana I. Because of the program's success and the belief shared by the GOI and USAID that much still needed to be done for this kind of small-scale irrigation development, Sederhana II was begun. At that time, USAID committed an additional $25 million loan and a $4.5 million grant to Sederhana. Another grant of $6.8 million was committed in 1980.

Three evaluations of Sederhana concluded that the program successfully built a large number of systems over a wide area. Further, and consistent with project objectives, the evaluations noted that these systems were constructed relatively quickly, brought a large amount of land under cultivation, and improved water reliability during both the wet and dry seasons in areas where there was some irrigation before the program began.

The Gray (1978) evaluation concluded that "although relatively young and unique [the Sederhana Project], is proving to be a worthwhile and effective program promoting increased rice production, increased income for the rural poor, and a strengthening of GOI and village institutional capacity to develop simple irrigation systems." However, while concluding that Sederhana helped increase production and income, this evaluation added that "the variability of success . . . presents some of the limitations which this national program confronts in specific local environments."

Other sources of information provide examples of these limitations and other shortcomings of Sederhana. These sources include reports from USAID staff, GOI personnel, academics, and farmers. Several kinds of problems were frequently mentioned:

- Poor system design and location. After systems were constructed, the water source was discovered to be inadequate for the designed area, resulting in less area irrigated than specified in the design.

- Non-functioning structures. Many turnouts did not work because they were too high, too low, poorly built, or incomplete (missing gates); canals were improperly located, did not hold water because they were built on porous soil, or were washed out; and diversion weirs were improperly located or poorly built

- Structures were destroyed or altered by farmers. These include "unofficial" turnouts or canals leading from the main system to farmers' fields, or deliberately destroyed turnouts or measuring devices.

- Poor maintenance. This occurred in both the main system and the tertiary system. Canals were allowed to fall apart without being rebuilt. Farmers claimed the government had to do the work. The government said the farmers had to do it, or that the farmers' misuse of canals, e.g., by allowing water buffaloes to bathe in them, caused the canals to fall apart. Many canals, both in the main system and tertiary system, were found to be full of silt or weeds.

Poor system operation. There were reports that some farmers did not get enough water when required while others got more than they needed. Water was often stolen, or taken out of turn.

Lower harvests and yields than were expected. A great deal of effort went into improving the physical condition of the irrigation system and into assuring that adequate quantities of water were delivered to the farmers. However, this did not appear to produce measurably higher yields.

There are usually two explanations for why these problems occur. One is that the most important decisions about small-scale irrigation systems are centralized, i.e., they are made in Jakarta or in Bandung instead of in the provinces or kabupatens (sub-provincial administrative districts). However, the argument has been presented that decisions made at the provincial or kabupaten levels could just as easily ignore farmers' wishes as do centrally made decisions. The second explanation is that farmers are not involved in the decisions.*

2.2 Project Rationale

The HPSIS grew from the combination of two notions: first, that the Sederhana Program was less successful than expected, and second, that the lack of success was due to the way decisions were made about developing Sederhana systems.** Together, these notions led to the formulation of a model of participatory irrigation development that underlies the HPSIS Project.

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*These arguments can be applied generally to government-supported small-scale irrigation projects. A more detailed description of the lack of participation in Sederhana systems is provided in Robinson (1985).

**The Sederhana Assessment Study (1985) argued that the major problems in Sederhana systems were due to poor site selection and poor design. This study did not include organizational questions; it was more concerned with describing the general physical conditions in Sederhana systems.

2.3 PID: A Model of Participatory Irrigation Development

Existing information about irrigation in Indonesia and other Asian countries, combined with recent theories that place high value on "beneficiary participation" formed the basis for the model of participatory irrigation development (PID). This model describes the linkages that are supposed to occur generally in participatory irrigation projects. The model also provides both the conceptual strategy for HPSIS and the guidelines to use in evaluating it.

The PID model has three parts: assumptions about why farmers should participate in irrigation development, assumptions about how they participate, and assumptions about the linkages between farmer participation in irrigation and certain benefits.

Assumption 1:

Why should farmers participate in irrigation development? Farmers traditionally have had little say in the important decisions affecting government systems--where they are to be built, how they are designed, how much they should cost, how quickly they should be built, how large should they be, who should run them, what crops should be grown on the irrigated land, and so forth. In contrast, there is substantial evidence from Indonesia and other Asian countries that farmers have been able to make many of those decisions on their own, in non-government systems, without assistance or interference from either national governments or foreign donors. These systems are often called "communal" or "community-managed" irrigation systems.

Participatory approaches have also been tried in government-funded irrigation projects in other Asian countries. The most famous examples of these are the Communal Irrigation Program in the Philippines and the Gal Oya Left Bank project in Sri Lanka.

Farmers participate in developing and managing irrigation systems for several reasons. First, farmers know what they want and need.

Second, farmers have special technical and other knowledge that is unavailable to outsiders. For example, farmers know about local systems of water and land rights that can affect the location of irrigation structures. Third, farmers have the greatest stake in how the irrigation system is built and operates. Finally, if farmers are brought into the early stages of system development, they are more likely to help with the later stages of system management.

Assumption 2:

How do farmers participate in irrigation development? According to the PID model, farmer participation in irrigation development generally occurs in stages. The stages sequentially parallel the growth of the irrigation system. Thus, there is participation in survey and design, in construction, in operations, and in maintenance. Farmers also participate in other areas such as conflict management and financial activities. Their experience in these activities can develop either along with or following the "irrigation" activities.

Assumption 3:

What are the effects of farmer participation in irrigation development? The model states that effective farmer participation brings about certain benefits, which occur in sequence. These include:

1. Better designed systems.
2. Better constructed systems.
3. Systems that stay in good physical condition for a reasonable period after they are built.
4. Better water distribution.

These changes in the irrigation system proper bring about other benefits to farmers. They include:

5. Greater use of inputs.
6. Higher total harvests.
7. Better yields.
8. Higher farm income.

2.4 Project Sites

Three types of sites were selected for project activities. Together, the three types (encompassing 21 HPSIS sites) represented different levels of technical completeness and provided a means of comparing the interactions of the physical and organizational development of irrigation.

The first type of site was the least developed physically: both major and tertiary works needed to be designed and constructed. These sites were called "system development" sites because their activities centered on construction rather than management. At these sites, both major and tertiary works were developed with the active participation of the water users. There were originally three of these sites, but one was eventually changed to be included with projects in the second site type.

The second type of site was partially complete physically, and in fact represents a large number of Sederhana projects. These sites were called "system development and management sites" because their activities included both construction and management of the irrigation system. The sites' major works were already built and functioning, but had no official tertiary works. At these eleven sites, the tertiary facilities were designed and constructed with the participation of water users.

The third type of site can be considered physically complete: both the main and tertiary works have been constructed and were supposed to be functional. These were called "system management sites" because no construction had been planned for them. At these seven sites, water users did not participate in the design and construction of the physical structures, but only in the operation and management of the irrigation system that was already in place.

2.5 Project Activities

A certain number of project activities were implemented at all of the sites; other activities were conducted at only a few. The standard activities included the following.

First, community organizers (COs) were assigned to help the farmers participate in system development through water users' associations (WUAs). While technical aspects of design, survey, and construction were discussed by the CO at those sites that experienced construction, COs also helped farmers to think about and interact on issues of future O&M and water management. After the systems were completed, farmers were expected to know that they had responsibility for maintaining the tertiary facilities, using the available water in the best and most agreeable way, and resolving their conflicts with a minimum of outside assistance. The COs were supposed to help prepare the farmers for these post-construction activities.

The CO role was originally conceived as non-technical. The idea was that the COs should limit their activities to stimulating and facilitating interactions between farmers and government. Experience has shown, however, that the COs should also have a good background in more "technical" areas, especially those who are assigned to sites where construction is being done. Farmers often relied on COs for technical information. If the COs could not provide the information themselves, they were expected to know which government agencies to contact for advice. Further, the COs were able to work more effectively with Ministry of Public Works (MPW) engineers and private contractors when they had some understanding of technical matters. The CO training thus became more technical than originally envisioned because the COs themselves found that they were more effective with such training.

The second activity was the collection of benchmark and evaluation data for all the pilot sites. The data were to be used for on-going monitoring and evaluation as well as final evaluation of the project. Because of delays, however, those data had little application in on-going monitoring.

The third activity was monitoring project implementation at the sites. This was a crucial but difficult activity because 21 sites were involved. Much of the information came from written monthly reports from the COs, whose detailed local knowledge of project activities was unmatched. These reports were supplemented by periodic trips made by a national project implementation team and meetings with local implementation teams. The existing monitoring system helped the central team keep track of issues and problems.

The fourth activity was training. Two groups of people were trained under the project. The first was farmers, who were trained in water management and organization of their WUAs. The second group was local government staff and locally assigned personnel of national line agencies who were involved in HPSIS and were likely to be involved in similar activities in the future.

The fifth activity was construction, which took place at the system development and system development and management sites. At most of these sites, farmers participated in the re-design and construction itself. At one site, construction began before farmers had much opportunity to participate (see Robinson, 1985 for more details).

2.6 Project Organization

HPSIS began in fourteen sites in April 1982, although the agreement formally creating the project was signed in August 1983. Seven other sites were added in January 1984. Activities at all sites continued through December 1985.

HPSIS was funded by the GOI ($1.067 million), the Ford Foundation ($119,000), and USAID ($1.4 million in loan funds and $2.12 million in grant funds). Activities at the 21 HPSIS sites were under the sponsorship of the Ministries of Public Works (MPW) and Agriculture (MOA). There were six MPW sites and fifteen MOA sites; the COs were financed and supervised through the sponsoring ministry. All of the sites were supervised and monitored by their respective provincial and kabupaten* implementation team, as well as by the central teams, all of which were inter-ministerial.

There is an historical reason for the division of jurisdiction. When the Sederhana Program started, the MPW was responsible for designing and constructing all structures in the main system. The MOA was responsible for designing and constructing all structures in the tertiary system, as well as for organizing the farmers. In 1979, however, MPW acquired responsibility for all construction, while MOA retained responsibility for tertiary water management and water users' associations. Nevertheless, the old division of responsibility was reflected in the administration of HPSIS.

The coordination of project activities among the Ministries of Agriculture, Public Works, and Home Affairs was formalized by a letter of agreement creating national Steering, Guidance, and Implementation Teams. (Although it did not sign the Sederhana Loan Agreement or Grant Agreement, the Ministry of Home Affairs (MHA) was included in the HPSIS project because of the importance of the local planning boards, or Bappedas, in irrigation planning.) The Implementation Team had day-to-day responsibility for decisions affecting the project. The team included representatives from the MPW, MOA and MHA, as well as USAID and the Ford Foundation.

*Kabupaten = regency or district

Two other means of coordination were established for the provinces and kabupatens. Under the general guidance of the national team, the provincial and kabupaten teams monitored, and to some extent, helped implement the project in their areas of jurisdiction. These teams consisted of representatives of the three ministries and others who worked on the project.

2.7 Testing the PID Model

One of the fundamental reasons for conducting the HPSIS project was to experiment with different kinds or degrees of farmer participation in irrigation. First, it was necessary to find situations that promote farmer participation and then to examine how farmer participation affects irrigation objectives. In particular, the project sought to measure quantitatively the benefits that are thought to flow from increasing farmer participation in the development of small-scale irrigation systems, the important factors that influence farmer participation, and the participation itself.

Studies of farmer participation were built into the HPSIS project in an activity called "impact assessment." Through the impact assessment, data were collected that could be used to measure farmer participation and some of the benefits that the PID model predicts will result from increasing farmer participation. The impact assessment focused on several kinds of farmer participation and several characteristics of farmers, farms, and sites. The strategy here was to see first whether HPSIS has changed the ways small-scale irrigation systems develop, and if so, whether the systems are any better.

Many factors are important for understanding farmers' ability and desire to participate in developing irrigation systems. Similarly, farmer participation can affect many irrigation objectives.

In designing the impact assessment, the most important of these factors--measuring physical changes at the sites and measuring water distribution at the sites--were chosen for investigation.

2.7.1 Measuring Farmer Participation

Several activities that farmers could participate in during the development of the irrigation systems were identified. These were design, construction, maintenance, and formal activities in the water users' associations. Those aspects of participation were quantified by simply counting the number of farmers who reported that they took part in the activities. The data thus allowed for an examination of many kinds of patterns and interactions.

In order to determine participation in designing their irrigation system, farmers were asked if they had:

- participated in planning the system,
- discussed the design with the contractor,
- discussed the design with MOA or MPW staff,
- discussed the design with other farmers, and/or
- participated in some other way.

Farmers were asked five questions about their participation in constructing the irrigation system. These were whether they had:

- participated generally in construction,
- helped build the tertiary canal,
- helped build a division box,
- helped build the secondary canal, and/or
- helped build the headworks (dam).

Farmers were asked seven questions about their participation in maintenance activities. These were whether they had:

- cleaned weeds from the main canal,
- cleaned weeds from the tertiary canals,
- cleaned the main canal of mud,
- cleaned the tertiary canals of mud,
- repaired the main canal,
- repaired the tertiary canals, and/or
- reported to someone in authority that a canal was damaged.

Finally, farmers were asked three questions about their formal activities in the water users' association. These concerned:

- their membership,
- whether they had ever served as an officer, and
- how often they attended meetings.

The farmers' responses to each group of questions were summarized, with one point given for each "yes" answer (except for the "formal activities" scale, which was slightly more involved). The results form a simple participation scale for the four kinds of participation.

2.7.2 Measuring Physical Changes

According to the PID model, the first beneficial change that farmer participation is supposed to bring about is improvements in the physical condition of the irrigation system. In order to test this proposition, data were collected on five kinds of physical structures.

1. Main system canals (in meters).
2. Main system structures (number of structures).
3. On-farm (tertiary and quaternary) canals (in meters).
4. On-farm structures (number of structures).
5. Drainage canals (meters).

For each kind of structure, data were obtained on how many meters or pieces were in the original design, how many were changed by the farmers, how many were part of the final design, and how many were actually constructed. In addition, information was collected on how much construction was done by MPW and its contractors, and how much was done by the farmers with and without pay.

For each of the five types of physical structures listed above, data were collected on the irrigation system before the HPSIS project and after the construction was completed, according to whether the structures were in good, fair, or poor condition. For the MOA System Management (SM) sites and the MPW system development and management (SDM) sites, data were also collected on the condition of the systems at a third time period, approximately one year after construction was completed. Third-period data were not obtained for the new MPW sites that were started in 1984.

The data on physical conditions came from several sources, including CO reports, trip reports, and information gathered during training programs, such as the training for WUA officers. Part of that training was a thorough system inventory that was done by farmers and training staff who walked through the entire system and recorded the conditions on a map. Finally, some of the most recent data were obtained from special field visits by USAID staff.

2.7.3 Measuring Water Distribution

After physical changes in the irrigation system, the next important change that was anticipated was improvement in water deliveries.

Measuring those changes can be done with different degrees of accuracy, sophistication, and effort. For example, one way is to measure the crop water requirement, evapotranspiration, seepage and percolation, rainfall, inflows, and outflows at different parts of the irrigation system. This information can be used to determine system performance. It provides accurate data but is very time consuming and requires much attention to equipment. It is also relatively expensive.

A second method is based on the concept of stress days. A stress day is any day over three consecutive days that the rice field is without standing water. After that, the rice plants are presumed to undergo water stress and, depending on when the stress occurs, there is a reduction in yield. This method requires no equipment, but it does require someone to observe paddy water status regularly throughout the crop season and at different locations in the system. It also requires some training for the observer, so that one person's stress day is equivalent to another's in a different system. Studies at the International Rice Research Institute (IRRI) have shown that the stress days are a good predictor of yield reduction. For the purposes of HPSIS, it would have been a good, but again relatively difficult, approach to use.

A third approach was taken for the HPSIS, which is less accurate than either of the above two, but which requires no extra personnel or equipment. Farmers were asked whether they had a water shortage, enough water for growing their crop, or more water than they needed for their crop. They were not asked whether they were satisfied with water deliveries, which can be a different matter. This approach lacks the precision of the others, but it has the virtues of being direct and focussed on the farmers rather than on calculations of crop water requirements.

Combining the "water adequacy" information with knowledge about farmers' location in the system produces two indicators of the system's ability to deliver water to the farms. Both indicators focus on the most common and intractable water distribution problem: maldistribution between the tailenders and farms in the rest of the irrigation system.

The first indicator is a water inadequacy ratio, which is the percentage of farmers in the whole system who have reported water shortages. It is formed simply by counting the number of farmers who reported such shortages and dividing by the total number of farmers.

The second indicator is a water maldistribution index, which is the difference between the percentage of farmers in the tail of the system who lack water with the overall percentage of farmers who lack water. For example, if 25 percent of all the farmers in a system report water shortages, but 35 percent of the farmers in the tail end of that system report water shortages, the maldistribution rate is .25 -.35 = -.10. This difference will usually be negative, which means that the percentage of farmers in the tail who are not getting enough water is greater than the percentage of farmers in the whole system who do not get enough water.

As either of these indicators becomes lower, it can be inferred that the irrigation system is doing a better job of delivering water.

3. FINDINGS AND CONCLUSIONS

This section contains the eight major findings and conclusions of the HPSIS project. The overall conclusion drawn from the project is that HPSIS has successfully introduced farmer participation in the development of small-scale government irrigation systems in Indonesia. The project's success can be attributed to assigning community organizers in project sites, monitoring their activities and the changes that took place at the sites, and working with appropriate local government agencies. This approach was a departure from the usual way in which government-supported irrigation systems are designed and built.

1. Through HPSIS, farmers have productively participated in both designing and constructing small-scale government irrigation systems in Indonesia.

Government-supported and managed irrigation has traditionally excluded farmers from important decisions and activities in irrigation system development, particularly in the early phases of design and construction. In contrast, farmers are often involved in many such decisions in "communal" irrigation systems. HPSIS has successfully involved farmers in design and construction, two crucial parts of system development in government irrigation projects.

Design. The original HPSIS designs were principally made by MPW staff or contractors, with very little input from farmers. However, in a significant departure from the usual design process, farmers negotiated design changes with the Ministry of Public Works. The designs were then revised with the participation of farmers, who both provided new information and argued for changes they thought were necessary.

Many of the changes that the farmers wanted were included in the final design. Altogether, farmers recommended changes that affected an average of .6 km of drainage canals, more than 2 km of on-farm canals, and more than 5 on-farm structures in each HPSIS system.

Although farmers in the system development and management (SDM) sites were responsible for many changes in the designs of their sites, farmers made even more changes in the MPW sites that were added in 1984. These farmers recommended changes that affected 4400 meters of on-farm canals, as opposed to 719 meters in the SDM sites. They also recommended adding an average of 880 meters of drainage canals, in contrast to the 325 meters of additional drainage recommended by farmers in the SDM sites.

The increase in the number of design changes had two implications. First, the COs assigned at the later MPW sites were able to build on the experiences of the COs at the earlier MOA sites and work more effectively with farmers and with the MPW. Second, the MPW became more receptive to the general idea of farmer participation in design and to the specifics of farmers' suggestions. By the time the MPW 1984 sites were started (four of the six were in provinces that had previous experience with SDM sites), the provincial Public Works staffs had some experience with HPSIS and therefore had some idea of what to expect from farmers and COs during HPSIS-style design.

Construction. Farmers constructed substantial parts of the HPSIS irrigation systems and contributed materials and tools that were used during the construction. (Data on construction are given in Appendix A.)

Most of the construction by farmers was a planned HPSIS activity. But some of the farmers' construction was unplanned. Some of the most interesting construction work took place at the system management sites, which were supposedly complete. With the help of COs, farmers at some of those sites rebuilt parts of the irrigation system on their own.

During construction, farmers often made suggestions and demands about how the system should be built. The suggestions included location of turnout structures, layout of canals and provision of drainage strcutures. Farmers negotiated these changes with Public Works staff. In the process, farmers gained confidence in their ability to make their views known to the government. At the same time, MPW staff began to take farmers' views more seriously.

2. <u>When farmers were included as active participants in system design and construction, the result was significantly better irrigation systems.</u>

Farmers constructed large portions of the HPSIS irrigation systems. Most of their work was done on the tertiary systems: canals, structures, and drainage canals. During HPSIS, farmers constructed 75 percent of the on-farm canals, 57 percent of the on-farm structures, and 71 percent of the drainage canals.

During the project, the general physical quality of the irrigation systems improved dramatically, although there was variation among systems and parts of systems. The percentage of the system in good condition was much higher, on average, at the end of the project. For example, 38 percent of the main system canals were in good condition at the beginning of the project and 85 percent were in good condition at the end of the project. For on-farm canals, comparable figures are 13 percent in good condition at the beginning of the project and 73 percent at the end. For drainage canals, the figures are 7 percent in good condition at the beginning of the project and 58 percent at the end.

In general, the more farmers participated in design and construction, the higher was the percentage of the irrigation system that was in good physical condition. It should be noted, however, that there appears to be a point of diminishing returns for farmer participation. (Data supporting this conclusion are found in Appendix A.)

3. <u>Although farmers became involved in maintenance, and to some extent in the systems' water management, it was easier for farmers to directly affect the physical quality of the irrigation system than to improve water distribution.</u>

In general, there was little or no direct connection between farmer participation and water distribution. However, farmer participation in constructing on-farm works had more effect on water distribution than their participation in constructing the main system. (Data supporting this conclusion are found in Appendix B.)

Overall, the physical condition of the system had more direct importance in determining water distribution patterns than farmers' efforts to change water distribution.

Taken together, conclusions 2 and 3 provide compelling reasons for having farmers involved in system design and construction. First, it is simply logical that farmers or the irrigation agencies will be able to distribute water more effectively in a well-built system. Thus, if farmers can contribute to improving the physical quality of the system, they should be encouraged to do so. Second, the incentives for farmers to maintain and operate irrigation systems will be greater in systems that are in manageable condition. When a system is in bad condition, the farmers' inclination to restore it is taxed. When it is good, however, they should experience a greater sense of ownership and be willing to take on greater responsibilities in maintenance within their capabilities. Third, when farmers and government can combine their efforts to produce good systems, relations between the two will be better and transitions of responsibility from government to farmers, which are bound to occur as government budgets are reduced, will be smoother.

4. HPSIS changed the ways local irrigation-related decisions are made at the project sites. The changes increased both the information and resources that farmers provided in developing the sites and the farmers' legitimacy in influencing local decisions.

The HPSIS project brought about productive exchanges of information and views between farmers and the irrigation agencies in sites where there had been very little previous contact between farmers and the agencies. The project also broadened community-level decision making on irrigation matters. Usually, the village head dominates decisions about solving irrigation problems. In the HPSIS sites, however, individual farmers took greater initiatives pertaining to irrigation.

5. HPSIS changed attitudes towards farmer participation in the Ministry of Public Works.

The idea that farmers would have an active role in design and construction was not generally accepted before HPSIS. In particular, MPW officials were not interested in farmers questioning designs that were made by trained engineers, and HPSIS was encouraging just that sort of challenge. Also, early planning discussions brought up the highly sensitive question of who should own the completed systems. At that time, MPW staff totally rejected the possibility of farmers owning systems that the government had built, even on a trial basis. Their most potent argument was that the law required MPW to retain formal responsibility for the systems built with governmental funds.

As discussions continued, MPW officials agreed that farmers could make suggestions about system design, but that the final decision would be made by their staff. During the project, however, real negotiations took place between farmers and MPW officials or contractors. Farmers often had views of what the systems should look like that were quite different from the official designs. Some of the farmers' views were based on technical criteria (for example, local drainage conditions or location of individual turnouts). Others made non-technical suggestions, for example, not putting a canal too close to the mosque. During these negotiations, there was give and take on both sides; and at many sites, this kind of farmer-government interaction was new.

Since the HPSIS began, there has been a perceptible change, especially among MPW officials, in how people talk about farmer participation. While there had always been interest in having farmers perform more maintenance, farmers' lack of participation in maintenance was sometimes used to question their independent involvement in design: if they can't even keep their canals clean and repaired, how they be expected to design new canals? In the course of HPSIS implementation, however, some staff members began to say that farmers need to be part of system development to avoid management problems after construction. Some even conceded that farmers can provide site-specific technical information that technical people would otherwise overlook.

The wider acceptance of this opinion in MPW is a significant development. It indicates that officials are considering possibilities that they didn't consider when HPSIS was being discussed and planned. And there are indications that the opinions are translating into action. Public Works offices in some provinces have started using their own version of COs. Further, the MPW has accepted the general CO approach for the new Small-Scale Irrigation Management Project (SSIMP), a new project implemented by the MPW with support from USAID.

HPSIS has shown that government and farmers can work as partners under the right conditions. As the Ministry continues to receive encouragement for considering different ways of developing irrigation, such as actively soliciting farmers' views, improvements can be expected in the effectiveness of their work.

6. <u>Farmer participation in irrigation development is not sufficient for reaching more "ultimate" objectives.</u>

The most important failure of the PID model is that it over-values farmer participation by expecting it to produce too many benefits by itself. There is a direct connection between farmer participation and the physical condition of the irrigation system. The more farmers are involved in system design and construction, the better off the systems are. But the direct effects of the participation ston there. They do not reach water distribution, nor do they produce changes in production and productivity.

7. <u>HPSIS has affected relations among line agencies at the provincial and kabupaten levels.</u>

Although irrigation is supposed to be a combined effort involving staff from local governments and the Ministries of Public Works and Agriculture, in practice, there is often little coordination among them. There are good reasons for this. In spite of having similar and even complementary objectives, each agency has its own budget and internal sets of priorities and constraints. These often inhibit the implementation of coordinated activities.

HPSIS created several levels of inter-ministerial teams. Most them never functioned, but some of them did. At the local (provincial and kabupaten) level, the most important teams were the implementation teams, which were supposed to have day-to-day responsibility for managing activities at the sites. In the beginning of the project, the teams lacked joint funding mechanisms for activities. There was also limited "coordination" among the agencies in the teams, mainly because the role of the teams was ill-defined.

By the end of HPSIS, several teams had joint budgets that did not rely on the national DIPs. Even in provinces where funds primarily came from the national budget, there was evidence that real joint activities were taking place in connection with HPSIS sites.

As government priorities in irrigation change, for example, from wet rice to diversified cropping, coordination among the Ministries of Agriculture, Public Works and Home Affairs will be even more important than it was for HPSIS. Targetting areas for irrigation development will require the active participation of agriculturists, engineers, and economists, because no single agency has enough expertise in all these areas.

8. <u>As has been the case in an increasing number of participatory development projects in recent years, a non-government organization had an essential role in HPSIS.</u>

One of the hallmarks of the pioneering work done in the Philippines on participatory irrigation development was the role of a working group that included both government and private sector organizations. The non-government groups were able to provide perspectives and take positions that helped the government line organization move in new directions. Although the HPSIS Central Implementation Team was not quite like the "Communals Committee" in the Philippines, it did play a similar coordinating role, largely because of Lembaga Penelitian, Pendidikan dan Penerangan Ekonomi dan Sosial (the organization that had primary responsibility for managing the COs).

In the beginning of the project, LP3ES's role was limited largely to recruiting, selecting, and training the COs. LP3ES had used workers similar to COs in previous rural development projects, but had little experience in irrigation before HPSIS. As the COs were assigned in the field, LP3ES took a central role in managing and guiding them. In the early stages of HPSIS, the COs' status was vague in several respects. Some viewed the COs as spokesmen for the farmers.

Some saw them as spokesmen for the government. LP3ES saw them as a bridge between the farmers and the government. But the local HPSIS implementation teams weren't sure what to do with the COs. Their potential for becoming a bridge between the farmers and the government was doubtful in the beginning because of this lack of definition of the role of the COs.

LP3ES visited the field more often than of the any other agencies on the central teams. At first, the visits were mainly to "monitor" the COs. LP3ES soon found that monitoring developed into guidance, and that led to advising the local HPSIS implementing teams. The contacts with the local implementing teams and agencies became more frequent and important for smooth project implementation. By filling the management gap for the COs, LP3ES also became a bridge between the central implementation team and provinces.

At the same time, LP3ES took major responsibility for organizing the COs' training and re-training. The COs were originally recruited and trained as non-technical organizers, which meant that they had only limited knowledge about irrigation. Because farmers began asking them more technical questions than they could answer, the COs' re-training included basic information on irrigation and more details about technical support available from the Ministries of Public Works and Agriculture.

In the process of organizing and retraining the COs, LP3ES expanded its own grasp of technical and organizational problems and issues in irrigation. As LP3ES took on increasing responsibilities in HPSIS, their influence grew. They served as a consistent and persuasive advocate of farmers' positions and needs, and of the importance of building effective farmer-oriented institutions at the project sites.

4. SUMMARY

HPSIS successfully introduced farmer participation into activities that usually did not involve farmers. This project represented the first time in Indonesia that deliberate, systematic, highly monitored and fairly well publicized attempts were made to do this in government irrigation systems. When HPSIS was being discussed and planned in 1981 and certainly before that, there were no guarantees that farmers could or would be involved in these activities. But the farmers did become involved in irrigation system development and management. That accomplishment, along with the project's external effects, is good cause for satisfaction.

Although many accomplishments were realized in the project, the benefits of increased participation have not been as significant as were originally hoped. That is because expectations for the project were optimistic and based on a wide-ranging generous model of participatory irrigation development.

Farmer participation is both a means and an end. In considering it as an end, HPSIS can be viewed as a real success. When looking at farmer participation as a means to other ends, however, there is more work to do. The approach still needs to be improved if changes in the more "distant" ends of the PID model are to be realized. Given the Indonesian Government's commitment to involving farmers in irrigation, the budgetary pressures that may speed up that involvement as they have in the Philippines, and the interest of donors, continued progress should be made in future projects.

5. REFERENCES

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APPENDIX A

PHYSICAL CHANGES IN THE HPSIS IRRIGATION SYSTEMS

During the course of the HPSIS project, dramatic physical changes were observed in the irrigation systems. Some of these changes are not surprising because the construction was done at 15 of the 21 sites. But the general trends suggest that new construction alone is not the explanation for the changes.

Data were collected on five kinds of physical structures in the main system and the tertiary system (see section 2.7.2). The data allowed the documentation of several kinds of changes that occurred.

Table 1 summarizes the quantitative changes in the HPSIS sites during the project. There was a relatively small increase in the average size of the main system canals (from 3800 to 4300 meters) and main system structures (from 18 to 22 pieces) during HPSIS.

There was a larger proportional increase in the amount of drainage canals (from 1720 to 2846 meters). And by far the largest increase occurred in the on-farm part of the irrigation systems, as would be expected, because that is where most of the HPSIS work took place. Before construction, there was an average of 6300 meters of canals and 8 pieces of structures at each HPSIS site. After construction, there were more than 16,000 meters of on-farm canals and 27 pieces of on-farm structures.

What is important to remember about these changes is that farmers participated in bringing them about. They participated in the design or redesign of the irrigation systems. They negotiated with the contractors and with staff from the local Public Works office on how the systems were to be built. They worked as laborers on the construction. In some

Table 1. Physical Changes in HPSIS Irrigation Systems

System size, main canals (meters)	Mean	Number of sites
Before construction (Time 1)	3800	20
After construction (Time 2)	4300	20

System size, main system structures (number of pieces)	Mean	Number of sites
Time 1	18	20
Time 2	22	20

System size, on-farm canals (meters)	Mean	Number of sites
Time 1	6280	21
Time 2	16670	21

System size, on-farm structures (pieces)	Mean	Number of sites
Time 1	8	21
Time 2	27	20

System size, drainage canals (meters)	Mean	Number of sites
Time 1	1720	20
Time 2	2846	19

cases, they were paid the going rate for construction labor; in some cases, they worked for reduced wages; and in some cases, they worked for free. In some cases they also provided materials and tools that were used in the construction of the system.

Table 2 shows farmers' participation in construction by reporting what percentage of the various parts of the system they constructed. In general, farmers participated more heavily in constructing the on-farm parts of the system: the irrigation canals and structures, and drainage canals. These figures show that there were important quantitative changes at the HPSIS sites, and that farmers were responsible for a good portion of them.

But there were also qualitative changes in the systems as indicated by data on the physical condition of various parts of the irrigation systems at the HPSIS sites. The data describe whether the system was in good, fair, or poor condition. Data were obtained for three periods. The first was near the beginning of HPSIS. The second was after construction was finished. The third (which necessarily does not include the system development sites) was for about a year after construction was finished. By lcoking at these data over time, one can get an idea of how the systems changed.

The general patterns in Table 3 show remarkable improvements in the quality of the systems during the HPSIS project. There was a dramatic change in the proportion of the main system canal that was considered to be in good condition. At the beginning of HPSIS, the percentage of main system canals in good condition was about 38 percent. At the second period, 77 percent of the main canals were in good condition, and at the third period, 85 percent were in good condition. The percentage in poor condition went from 19 percent near the beginning of the project to 4 percent near the end.

Table 2. Percent Site-by-Site Construction Done by Farmers under the HPSIS Project

	Mean	Number of sites
Main system canals (meters)	28%	11
Main system structures (pieces)	11%	14
On-farm canals (meters)	75%	17
On-farm structures (pieces)	57%	17
Drainage (meters)	71%	12

Table 3. Qualitative Changes in Main System Canals

Percent main system canals in good condition

	Mean	Number of sites
Time 1	38%	20
Time 2	77%	20
Time 3	85%	14

Percent main system canals in fair condition

	Mean	Number of sites
Time 1	43%	20
Time 2	18%	20
Time 3	12%	14

Percent main system canals in poor condition

	Mean	Number of sites
Time 1	19%	20
Time 2	5%	20
Time 3	4%	14

There was not much improvement in main system structures, because 80 percent of them were found to be in good condition even before HPSIS started. See table 4.

Table 4. Qualitative Changes in Main System Structures

Percent main system structures in good condition

	Mean	Number of sites
Time 1	80%	20
Time 2	88%	20
Time 3	82%	14

Percent main system structures in fair condition

	Mean	Number of sites
Time 1	12%	20
Time 2	7%	20
Time 3	11%	14

Percent main system structure in poor condition

	Mean	Number of sites
Time 1	8%	20
Time 2	5%	20
Time 3	7%	14

There were also impressive changes in the condition of on-farm canals, and good improvements in on-farm structures (see Tables 5 and 6). At the beginning of HPSIS, only about 13 percent of the on-farm canals were in good condition. After construction and about a year after construction, more than 70 percent of the on-farm canals were in good condition. Similarly, at the beginning of the project about 35 percent of the on-farm canals were in poor condition, whereas a year after construction, only 10% were in poor condition. On-farm structures also showed increases in the "good" category and small decreases in the "poor" category.

Table 5. Qualitative Changes in On-farm System Canals

Percent on-farm canals in good condition

	Mean	Number of sites
Time 1	13%	13
Time 2	74%	20
Time 3	73%	14

Percent on-farm canals in fair condition

	Mean	Number of sites
Time 1	15%	13
Time 2	21%	20
Time 3	17%	14

Percent on-farm canals in poor condition

	Mean	Number of sites
Time 1	35%	13
Time 2	6%	20
Time 3	10%	14

Table 6. Qualitative Changes in On-farm System Structures

Percent on-farm structures in good condition

	Mean	Number of sites
Time 1	59%	9
Time 2	92%	19
Time 3	75%	14

Percent on-farm structures in fair condition

	Mean	Number of sites
Time 1	23%	9
Time 2	4%	19
Time 3	14%	14

Percent on-farm structures in poor condition

	Mean	Number of sites
Time 1	18%	9
Time 2	4%	19
Time 3	11%	14

The same holds for drainage canals (Table 7). There were increases in the "good" category, from 7 percent to 58 percent, while the "poor" category held relatively constant at 14 percent.

To summarize, the data on physical changes in the irrigation systems show that (1) the systems have generally improved during the HPSIS project, and certain of these changes have been dramatic, and (2) farmers have participated in bringing about those changes.

But these patterns are only aggregate trends. They do not establish a direct connection between farmer participation and, for example, improvements in the physical system. In other words, just because farmer participation has, on average, increased at the sites and physical conditions of the irrigation systems have improved on average at the sites doesn't mean that the participation has caused the improvement.

To look more directly at the connection between farmer participation and the physical condition of the irrigation system, the average farmer participation scores (for the kinds of activities described in Section 2.7.1) were calculated for each HPSIS site. The average scores were then analyzed together with the data describing the physical conditions at the sites.

If the PID model holds, there should be positive correlations between HPSIS sites with high participation scores and the HPSIS sites with high percentages of their system in good condition. At the same time, negative correlations should occur between HPSIS sites with high participation scores and HPSIS sites with high percentages of their system in poor condition.

Table 7. Qualitative Changes in Drainage Canals

Percent drainage canals in good condition

	Mean	Number of sites
Time 1	7%	7
Time 2	58%	13
Time 3	58%	10

Percent drainage canals in fair condition

	Mean	Number of sites
Time 1	77%	7
Time 2	30%	13
Time 3	26%	10

Percent drainage canals in poor condition

	Mean	Number of sites
Time 1	15%	7
Time 2	12%	13
Time 3	16%	10

In general, the relationships are as predicted (see Table 8), with the strange exception of farmer participation in maintenance, which has the "wrong" sign. (That means that more farmer participation in maintenance correlates with lower percentages of "good" and higher percentages of "poor" variables measuring physical conditions.)

This pattern shows that quantity of maintenance does not equal the quality of maintenance. In other words, having many farmers involved in maintenance does not guarantee that the work they do is good. Perhaps the maintenance is not frequent enough, perhaps it is not well organized (it may not be on those parts of the system that need the most maintenance), perhaps the farmers don't do good work, or perhaps the timing of the work is not right. (In addition, of course, physical factors such as soil, slope or length of canal may require considerably more maintenance at one site versus another; perhaps the demands of such a system exceed the farmers' ability or interest to contribute to the maintenance.)

So far this discussion of farmer participation has focused on the frequency that farmers reported performing activities. But there are other ways of measuring farmer participation. Another way to look at farmer participation in construction, for example, is to see how much of total construction was done by farmers. As reported earlier, much of the construction was done by farmers, especially on-farm construction. If the PID model is working, the more construction work is done by farmers, the better the systems ought to be.

The data show exactly the opposite. Table 9 shows the correlations between the percent of construction done by farmers and the corresponding condition of the system. The correlations are the "wrong" way, and consistently so. This means that the greater the percentage of construction done by farmers, the worse will be the condition of the structures at Time 3.

Table 8. Correlations between Farmer Participation and Physical Condition of the Irrigation Systems

Farmer Partcpn.	Good Main Canal	Poor Main Canal	Good Main Structs.	Poor Main Structs.	Good On-farm Canals	Poor On-farm Canals
Design	.0910 (10)	-.3616 (10)	.3181 (10)	-.4120 (10)	.0149 (10)	-.1934 (10)
Constr.	.0771 (9)	-.3462 (9)	.3274 (9)	-.3840 (9)	.1396 (9)	-.3347 (9)
Maint.	.1351 (10)	-.3974 (10)	-.1457 (10)	-.2715 (10)	-.5050 (10)	.2754 (10)
Formal	.5042 (10)	-.7585 (10)	.2279 (10)	-.5276 (10)	.0649 (10)	-.0807 (10)

(Coefficient/(Cases)

Farmer Partcpn.	Good On-farm Structs.	Poor On-farm Structs.	Good Drainage Canals	Poor Drainage Canals
Design	-.2901 (10)	-.0769 (10)	.2245 (7)	-.2453 (7)
Constr.	-.3144 (9)	-.0854 (9)	.2508 (6)	-.4872 (6)
Maint.	-.2309 (10)	-.0858 (10)	-.3584 (7)	.4701 (7)
Formal	.2745 (10)	-.4450 (10)	.4485 (7)	-.1896 (7)

(Coefficient/(Cases)

Table 9. Correlations between Physical Condition of the Irrigation System and Percentage of the System Constructed by Farmers

Percentage	Good Main Canal	Poor Main Canal	Good Main Structs.	Poor Main Structs.	Good On-farm Canals	Poor On-farm Canals
Main System Canal	-.2878 (6)	.3090 (6)				
Main System Structs.			-.3345 (9)	.6633 (9)		
On-Farm Canals					-.2102 (10)	.0189 (10)

	Good On-farm Structs.	Poor On-farm Structs.	Good Drainage Canals	Poor Drainage Canals
On-Farm Structs.	-.0817 (10)	-.4082 (10)		
Drainage Canals			-.7151 (6)	.5599 (6)

(Coefficient / (Cases)

Thus, there are two apparently conflicting patterns. On the one hand, when we measure farmer participation by keeping track of the number of farmers that are involved in construction or design, and the number of activities they take part in, that measure correlates positively with the physical condition of the system. And this pattern supports the PID model, which posits that the more farmers are involved in construction and design, the better the systems are. On the other hand, when we measure farmer involvement by keeping track of the percentage of construction that is done by the farmers, the opposite pattern holds: the more farmers are involved in construction, the worse the physical condition of the system.

The explanation for these conflicting patterns appears to be that it is more important to maximize the number of farmers involved in construction and design than it is to maximize the amount of work that farmers do. It may be that the HPSIS tried to get farmers to do too much of the total amount of work. There may be diminishing returns in quality when farmers do too much work, especially if the work requires certain skills that farmers are not likely to have.

There were reports from several of the construction sites that work was delayed because farmer-laborers and contractors couldn't agree on the wages to pay the farmers. The project officers and the COs may have pushed too hard to get farmers working as laborers with the result that the work wasn't as good as it might have been if the contractors selected their laborers in the usual manner. If they had, the contractor would presumably have chosen people with the necessary skills and motivation, whether they were farmers or not. And it may be that farmers are less motivated or have less time to work as laborers than we think.

The PID model assumes that farmers, if given the chance, will all volunteer to construct "their" irrigation systems. Or at least that they will become laborers at lower pay than "normal" laborers. Furthermore, they will work hard and effectively because they have a great stake in the quality of the irrigation system. But perhaps this isn't true, and perhaps this shouldn't be encouraged. The data suggest that it is better to get many farmers constructing a smaller portion of the system, perhaps work that takes only a few days, than it is to get many farmers to construct large parts of the system.

The primary benefits of farmer participation appear to be in the form of avoiding problems rather than of bringing about solutions, at least as far as irrigation construction is concerned. And the mechanism for avoiding problems might involve that hard-to-define phenomenon called the "sense of belonging." Generating that "sense" may reduce the tendency for deliberate destruction of those parts of the irrigation system that farmers do not approve of. And that may be more important for the overall health of a system than having most of the system built by farmers.

APPENDIX B

Changes in Water Distribution during the HPSIS Project

According to the PID model, if farmers participate in irrigation system development and management, water distribution should improve. As discussed in Section 2.7.3, the ability of the irrigation system to deliver water was examined indirectly by focusing on its inverse--water inadequacy (the percent of farmers reporting that they didn't have enough water during the growing season-- all the rest of the farmers had either just enough or more than enough water for their crop). If water distribution is improving, this water inadequacy fraction should go down.

The water inadequacy ratio was used to measure whether the irrigation system was delivering water equitably. The most common and important general problem in Asian irrigation systems is that farmers located towards the tail end of the system tend to suffer from water shortages. Thus, the percentage of farmers in the tail who reported water shortages was compared with the percentage of farmers in the whole system who reported water shortages. This comparison was made by subtracting the percentage of water-short farmers in the tail from the percentage of water-short farmers in the whole system. The difference between the two percentages was called the water maldistribution index (MALDIS).

If 25 percent of all the farmers in a system report water shortages but 35 percent of the farmers in the tail end of that system report water shortages, the maldistribution index is .25 - .35 = - .10. We expect that this difference will usually be negative, which means that the percentage of farmers in the tail who don't get enough water is greater than the percentage of farmers in the whole system who don't get enough water. (If the difference turns out to be positive, it means that farmers in the tail are getting better water deliveries than farmers in the system as a whole.)

With two measures of water distribution--the water inadequacy ratio and the water maldistribution index--plus the individual farmers' reports of their own water adequacy, patterns of water distribution in the HPSIS sites begin to emerge. Next, it is necessary to see whether there is any connection between them and the participation variables.

Table 10 shows that there has been very little change overall in water adequacy. During the first round of data collection, about 16 percent of farmers reported water shortages. During the third, it was 17 percent. These percentages are so close that they can be considered unchanged, which means that overall, the percentages of farmers who are experiencing water shortages has not changed. (The second round included only the MPW sites. Because the sites were under construction at that time, it is not difficult to understand why so many farmers (40 percent) reported a water shortage.)

Table 11 shows that 50% of the farmers reporting water shortages were in the tail. (Also 24% of the people in the tail were reporting water shortages.) The other 50% who reported those shortages were about evenly split between the head and middle.

The trend shows some movement towards equitability. During the third data collection, of all the farmers reporting water shortages, 41% were in the tail, 35% were in the middle, and 24% in the head.

Given these trends, there are two sets of questions to ask in connection with farmer participation. First, did farmers who participated in system development and management get better water deliveries than farmers who participated less? Second, did systems with higher farmer participation have better water distribution than systems with less farmer participation?

Table 10. Adequacy of Water Deliveries to Farmers

First Stage

Amount of Water Received	Frequency	Percent	Valid Percent	Cum. Percent
More than enough	173	18.1	18.4	18.4
Just right	617	64.4	65.7	84.1
Not enough	149	15.6	15.9	100.0
	19	2.0	MISSING	
TOTAL	958	100.0	100.0	

Valid Cases 939 Missing Cases 19

Second Stage

	Frequency	Percent	Valid Percent	Cum. Percent
More than enough	44	4.6	18.5	18.5
Just right	100	10.4	42.0	60.5
Not enough	94	9.8	39.5	100.0
	718	74.9	MISSING	
	2	.2	MISSING	
TOTAL	958	100.0	100.0	

Valid Cases 238 Missing Cases 720

Third Stage

	Frequency	Percent	Valid Percent	Cum. Percent
More than enough	58	6.1	7.7	7.7
Just right	571	59.6	75.3	83.0
Not enough	129	13.5	17.0	100.0
	200	20.9	MISSING	
TOTAL	958	100.0	100.0	

Valid Cases 758 Missing Cases 200

Table 11. Cross Tabulation of Water Adequacy by Location of Farm

First Stage

Count / Row Pct / Col Pct	Head 1	Middle 2	Tail 3	Row Total
1 More than enough	82 47.4 25.9	45 26.0 14.3	46 26.6 15.0	173 18.5
2 Just right	201 32.6 63.4	229 37.2 72.9	186 30.2 60.8	616 65.7
3 Not enough	34 23.0 10.7	40 27.0 12.7	74 50.0 24.2	148 15.8
Column Total	317 33.8	314 33.5	306 32.7	937 100.0

Number of Missing Observations = 21

Second Stage

Count / Row Pct / Col Pct	Head 1	Middle 2	Tail 3	Row Total
1 More than enough	32 72.7 40.0	8 18.2 10.1	4 9.1 5.1	44 18.5
2 Just right	31 31.0 38.8	37 37.0 46.8	32 32.0 40.5	100 42.0
3 Not enough	17 18.1 21.3	34 36.2 43.0	43 45.7 54.4	94 39.5
Column Total	80 33.6	79 33.2	79 33.2	238 100.0

Table 11 (continued)

Third Stage

Count Row Pct Col Pct	Head 1	Middle 2	Tail 3	Row Total
1 More than enough	20 34.5 7.8	18 31.0 7.1	20 34.5 8.1	58 7.7
2 Just right	207 36.3 80.2	191 33.5 75.2	173 30.3 70.3	571 75.3
3 Not enough	31 24.0 12.0	45 34.9 17.7	53 41.1 21.5	129 17.0
Column Total	258 34.0	254 33.5	246 32.5	758 100.0

The first was tested by correlating farmer participation with the farmers' reports of their water deliveries. The results were inconclusive. In general there was little or no connection between farmer participation and the adequacy of water deliveries.

The second question was tested by correlating the farmer participation scales with the water inadequacy ratio and the water maldistribution index. If the PID model is working, higher levels of participation should correlate with lower levels of both the inadequacy ratio and the maldistribution index. The correlations should be negative.

Table 12 shows that some of them are negative and some of them aren't. In particular, the correlations from the second stage of data gathering are quite unsupportive of the PID model, but they are all from the new sites that were added in 1984 and were undergoing construction at the time. The last group of correlations is the one to concentrate on because it is from the most recent data collection. It gives a very mixed picture. The correlations are generally fairly weak, and the signs in the "MALDIS" row are all "wrong" (i.e., they are positive, which is counter to what to expect under PID).

It is fair to conclude from these patterns that there is no clear connection between farmer participation and water distribution. This is the case whether we are talking about reducing water inadequacy or reducing inequitable water distribution.

Table 12. Correlations between Farmer Participation Scales and Water Distribution Variables

First Stage Farmer Participation in

Formal	Design	Constr.	Maint.	
Water Inadequacy	-.3767 (19)	-.3126 (19)	-.5163 (19)	-.2663 (17)
Maldis-tribution	.0048 (19)	-.1602 (19)	-.0255 (19)	-.2214 (17)

(Coefficient / (Cases)

Second Stage
Farmer Participation in

Formal	Design	Constr.	Maint.	
Water Inadequacy	.1976 (6)	-.0448 (6)	-.5158 (6)	-.3609 (6)
Maldis-tribution	.6326 (6)	.8372 (6)	.7452 (6)	.8607 (6)

(Coefficient / (Cases)

Third Stage
Farmer Participation in

Formal	Design	Constr.	Maint.	
Water Inadequacy	.2829 (17)	-.0092 (16)	-.1668 (17)	-.3791 (17)
Maldis-tribution	.0778 (17)	.0323 (16)	.0964 (17)	.0110 (17)

(Coefficient / (Cases)

PUBLICATIONS OF GENERAL INTEREST
AVAILABLE FROM USAID/INDONESIA

1. A Preliminary View of Indonesia's Employment Problem and Some Options for Solving It, by Robert L. Rucker, September 1985.

2. Demographic Background and Births Averted: Indonesian Family Planning, 1980-1984, by John A. Ross, Terry Hull, Lulu D. Bost, and David L. Piet, October 1985.

3. Public Expenditure Impact: Education and Health, Indonesian Family Planning, by Dennis N.W. Chao, John A. Ross, and David L. Piet, October 1985.

4. A Survey of Private Sector Training in Indonesia, by Grant Cox, November 1985.

5. An Epidemiological Approach to Health Planning and Problem Solving: A Case Study from Aceh Province, Indonesia, by Steven L. Solter, Ali Azir Hasibuan, and Burhanuddin Yusuf, February 1986.

6. Developing Manpower for Indonesia's National Family Planning Program: BKKBN's Experience with Overseas Graduate Training 1983-1985, by Dr. Santoso S. Hamijoyo, Dr. Thomas R. D'Agnes, and Drs. Slamet Sudarman, April 1986.

7. The High Performance Sederhana Irrigation Systems Project, by David M. Robinson, May 1986.