PN-ABK-659
76054

PRIVATIZATION AND SUSTAINABILITY OF SMALL-SCALE IRRIGATION IN INDONESIA:

A REASSESSMENT OF SEDERHANA AND HPSIS SYSTEMS

ISPAN
IRRIGATION SUPPORT PROJECT
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A REASSESSMENT OF SEDERHANA AND HPSIS SYSTEMS

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September 1991

A Small Scale Irrigation Management Project Applied Study
Prepared for the USAID Mission to Indonesia
by the Irrigation Support Project for Asia and the Near East
under ISPAN Activities No. 654B and 669B

Irrigation Support Project for Asia and the Near East
Contract No. ANE-0289-C-00-7044-00, Project No. 398-0289
serving Asia and Private Enterprise Bureau and Europe and Near East Bureau
U.S. Agency for International Development
Washington, D.C. 20523

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ACRONYMS AND TERMS

ADB	Asian Development Bank
A.I.D.	Agency for International Development
AMR	average monthly rainfall
BAPPEDA	Regional Development Planning Board (*Badan Perencanaan Pembangunan Daerah*)
BAPPENAS	National Development Planning Board (*Badan Perencanaan Pembangunan Nasional*)
bengkok	rights to land given to village officers as payment for services
bupati	district head
CO	community organizer
desa	village
DOA	Department of Agriculture
DOI I	Directorate of Irrigation I
DOI II	Directorate of Irrigation II
Drs.	equivalent of B.A. from Faculty of Social Science or Education, a form of address (*doctorandus*)
GOI	Government of Indonesia
gotong royong	cooperative work, mutual self-help
ha	hectare
HPSIS	High Performance Sederhana Irrigation Systems Project
IBRD	International Bank for Reconstruction and Development
IIMI	International Irrigation Management Institute
IISP	Integrated Irrigation Sector Project (ADB)

IPB	Bogor Agricultural University (*Institut Pertanian Bogor*)
IPEP	water service fee in South Sulawesi (*Iuran Pembiayaan Eksploitasi dan Pemeliharaan*)
Ir.	engineer, form of address (*Insinyur*)
irigasi desa	farmer-managed irrigation
irigasi sederhana	technologically "simple" irrigation
ISF	irrigation service fee
ISPAN	Irrigation Support Project for Asia and the Near East
ISSP	Irrigation Subsector Project (IBRD)
JaBar	West Java (*Jawa Barat*)
juru pengairan/kepala subranting	PRIS system officer responsible for roughly 1,000 hectares
kabupaten	district
kecamatan	subdistrict
kelompok tani	village-based farmers group
kepula desa	village head
kepala dusun	subvillage head
LKMD	Institute of Village Community Resilience (*Lembaga Ketahanan Masyarakat Desa*)
LP3ES	Institute for Economic and Social Research, Education, and Information (*Lembaga Penelitian Pendidikan dan Penerangan Ekonomi dan Sosial*)
lps	liters per second
mandor uwae/mandor jene	water overseer in South Sulawesi
MOA	Ministry of Agriculture
NGO	non-governmental organization
NTB	West Nusa Tenggara (*Nusa Tenggara Barat*)

NTT	East Nusa Tenggara
O&M	operation and maintenance
P3A	water users association (*Perkumpulan Petani Pemakai Air*)
palawija	secondary food crop, food crop other than rice
pecatu	temporary rights to village land in payment to a water users group leader on Lombok
pekasih	water master, head of water users group on Lombok and Bali
penjaga pintu air	gatekeeper
PIK	system turnover program (*Penyerahan Irigasi Kecil*)
pinati	village elder
PPA	Center for Agribusiness Development (*Pusat Pengembangan Agribisnis*)
PPL	agricultural extension worker (*Penyuluh Pertanian Lapangan*)
PRIS	Provincial Irrigation Service (*Dinas Pengairan Propinsi*)
PU	Ministry of Public Works (*Departemen Pekerjaan Umum*)
RD	rainfall distribution
Repelita	Five-Year Development Plan (*Rencana Pembangunan Lima Tahun*)
rupiah	Indonesian currency (US$1 = Rp. 1957 in July 1991 and Rp. 670 in 1980)
sarjana	university degree (four to five years)
sarjana muda	university degree (three years)
sawah	wet rice field
SD	system development
SDM	system development and management
Sederhana	technologically "simple" and Sederhana Irrigation Project

Sekolah Menengah Atas	senior high school
SM	system management
SSIMP	Small-Scale Irrigation Management Project
subak	indigenous water users group on Lombok and Bali
SulSel	South Sulawesi (*Sulawesi Selatan*)
swineh	payment to irrigation leaders, usually in the form of unhusked rice
TISP	Third Irrigation Sector Project (ADB)
tokoh masyarakat	informal community leader
TP4	community organizer exclusively involved in system turnover (*Tenaga Penimbing Petani Pengelola*)
ulu-ulu	ditch tender, head of water users group in West Java
USAID	U.S. Agency for International Development/Mission to Indonesia
WUAO	water user association organizer

ACKNOWLEDGMENTS

This study represents 18 months of often very concentrated efforts. ISPAN would like to thank USAID and the Government of Indonesia for the opportunity to undertake this reassessment of the Sederhana and HPSIS Projects. An examination of the long-term impact of development efforts is still an unusual exercise; donors and host governments will increasingly have to conduct longitudinal studies if project performance is to be improved. The approach of this assessment is a much needed counterbalance to the more common evaluations conducted soon after project implementation ceases.

Staff of the Ministry of Public Works, from senior officers to field-level workers, were uniformly cooperative and generous with their time to members of the team. All displayed an impressive commitment to the development of small-scale irrigation and a sincere interest in enabling farmers to manage their irrigation systems better. The team would particularly like to thank Ir. Sunarno, Ir. Winarno, and Ir. Sukarso Djunaedi of Irigasi I for their constant interest and support shown through their active participation at numerous meetings and their incisive comments on several drafts.

Dr. Herbert Blank and Ir. Joes Oemarhamzah of USAID/Jakarta are owed a large debt of gratitude for their encouragement, assistance, and patience throughout the study. Herb provided substantive input, particularly in dealing with policy issues and was excellent company on field trips where he displayed impressive interviewing skills. Joes is USAID's historical memory for Sederhana and HPSIS and was a much needed and always helpful resource. Both Herb and Joes read several drafts of the study and provided regular feedback to team members which helped shape the approach and the direction of the study.

The team would like to thank Ms. Suzanne Siskel of the Ford Foundation, Dr. Sam H. Johnson III of the Consortium for International Development, and Dr. Jan Gerards of the Euroconsult ISF Project. All were intimately involved in the Sederhana and HPSIS Projects or their aftermath. They reviewed an earlier draft report and provide useful comments which have found their way into this final version. Of course, the responsibility for the contents of this report rests with the team.

The case studies of three HPSIS systems were prepared by Dr. Jenny Masur.

EXECUTIVE SUMMARY

In May 1989, the U.S. Agency for International Development (USAID) in Jakarta requested that the Irrigation Support Project for Asia and the Near East (ISPAN) design and conduct a reassessment of USAID's long-concluded Sederhana I, Sederhana II, and High Performance Sederhana Irrigation Systems (HPSIS) Projects. These three projects were implemented from 1975 to 1985 through the Indonesian Ministry of Public Works (PU) and the Ministry of Agriculture (MOA).

The Government of Indonesia (GOI) and USAID regard the Sederhana and HPSIS Projects as seminal efforts to aid small-scale irrigation development, particularly through physical infrastructure investment, introduction of the water users association (*Perkumpulan Petani Pemakai Air* or P3A), and use of the community organizer (CO) to work directly with farmers and enhance the viability of the newly created associations. Sederhana I was the GOI's first intervention in small-scale irrigation systems. Until that time, small-scale systems—defined as those having fewer than 2,000 hectares—had been managed exclusively by farmers.

This study of the Sederhana I, Sederhana II, and High Performance Sederhana Irrigation Systems (HPSIS) Projects was designed to determine the extent to which the three projects have been sustained in organizational, technical, and agricultural terms since their implementation from 1975 to 1985. The assessment was to identify factors that have supported or impeded sustainability at the project sites.

The study's focus on privatization, in addition to sustainability, reflects an interest in determining whether the way farmers are operating systems since project termination indicates their improved capacity to manage the systems, and thus supports the GOI's present system turnover activities.

The Sederhana Applied Study is a departure from final project evaluations in that it explores project impact after a considerable length of time has elapsed: the Sederhana and HPSIS Projects ended from five to ten years ago. The study, which emphasizes the current situation in the systems rather than the specifics of project implementation, is not meant to be an evaluation of technical assistance provided or of GOI collaborative efforts.

Sederhana

The Sederhana Project was the GOI's first direct investment in the improvement, completion, and development of main and tertiary branches of small-scale irrigation systems. Sederhana did virtually nothing to foster a participatory approach that would involve village leaders or water users in system development. Sites for Sederhana implementation were selected by Provincial Irrigation Service (*Dinas Pengairan Propinsi* or PRIS) officers, usually at the district level. Irrigation design and development took place without the involvement of the village government officers. Nor were traditional irrigation leaders consulted about the plans covering the location, size, and working network of canals and irrigation facilities during the design phase of the project. The design was submitted to Ministry of Public Works (*Departemen Pekerjaan Umum* or PU) headquarters for approval, and, with few exceptions, only then was it shown to farmers.

After completing construction at each site, responsibility for the main system transferred from the farmers to PU. Two PRIS staff, a dam watcher and gatekeeper, operated and maintained the main system. (Gate watchers open and close the dam gate and regulate the water discharge from the dam; gatekeepers open and close the division or off-take gate and maintain the main canal.) In most cases

the dam watcher and gatekeeper were farmers from the system.

Agricultural extension bureaus in the provinces had ongoing programs introducing rice varieties and palawija crops and demonstrating new fertilizers, but no special activities in agriculture or farm management were introduced under Sederhana. Because it focused largely on physical infrastructural improvements and lacked an agenda to enhance farmer participation, Sederhana is often characterized as a project with no specific institutional development objectives. Although clearly defined groups or clusters of farmers under recognized leaders existed in all of the systems, little effort was made to work with or through them. No efforts were made to design or reach agreement on improved operations and maintenance (O&M) schedules emerging from structural improvements. Nor were efforts made to build upon physical infrastructural improvements by concurrently introducing P3As or other organizational innovations.

However, Sederhana did introduce highly significant institutional changes that are still in place today. Through Sederhana, PU for the first time established a permanent presence and claimed responsibility for main system O&M, previously in the hands of the village government or farmer-appointed leaders. In some cases, these responsibilities shifted to the village government rather than to PU.

This shift in responsibilities was a more significant change in system operation than the government's widespread and unsuccessful efforts to establish homogeneously structured P3As throughout the country. The shift not only weakened the irrigation role of the village government and farmers but also unwittingly undermined P3A organizing efforts, since in these new entities farmers had less power than in traditional arrangements. As a result, P3As offered few attractions to farmers.

The most immediate and dramatic impact of Sederhana's improvements in the physical system was the introduction of a second irrigated crop. Farmers no longer were restricted to growing palawija. At most sites, the actual irrigated area in the wet season increased from single to double paddy, and in some cases there was also a single palawija crop.

Since project implementation ended, the farmers' cropping pattern has not changed significantly. However, the cropping intensity has increased because of better use of inputs, improved cultural practices, and increased availability of irrigation water for growing rice and palawija crops during the dry season.

HPSIS

HPSIS had little, if any, long-term institutional impact in the study sites. Despite several years of GOI efforts to create and sustain new management entities in the HPSIS systems, farmers clearly demonstrated their reluctance to participate in and sustain the P3As much beyond the time a community organizer was in place working with them. Following project implementation, there were no meetings or other P3A activities. The P3A collects no fees, and officers are not paid a salary or honorarium. Administrative files of the P3A have disappeared or are inactive, and the only relic of the P3As in most systems is a guest book, which is pulled out when visitors come to P3A offices. These offices, a holdover from the days of HPSIS implementation, play no active role.

The introduction of community organizers (COs) as organizational catalysts in the P3A efforts was probably HPSIS's most distinctive and original intervention. The COs were to change the face of the program, signifying PU's continuing commitment to institutional change at the system level. However, once the COs left the systems,

farmers either quickly reverted to the arrangements they had in place previously or adjusted by ceding responsibility to village or local government entities.

Farmers returned to preproject arrangements to manage irrigation O&M, particularly in the tertiary systems. The involvement of PU in small-scale irrigation development and main system management, begun earlier during the Sederhana Project, has been far longer lasting. The pattern of the division of responsibilities among farmers, village government, and GOI is surprisingly regular in the systems: an overall division of responsibilities for main and tertiary system O&M has taken hold. This pattern is evident in the Sederhana sites, so it is difficult to attribute the division largely to HPSIS. Farmers in all 10 systems also continue to participate in main system operation and maintenance.

The greatest long-term impact if HPSIS has undoubtedly been upon the thinking of PU headquarters staff and their provincial officers. When HPSIS was first designed and implemented, the community organizers program was an experimental approach to secure greater farmer participation in O&M. That program has now proven itself sufficiently to PU, which believes that the CO function must be an integral part of the future development of small-scale systems. Issues presently under discussion and nearing resolution concern who may best play that role; the necessity and effectiveness of the function are not at issue.

HPSIS emphasized system management improvement rather than physical infrastructure development, with the exception of those systems that lacked permanent main systems. Dry season irrigation in the sites was disappointing because of poor site selection at the start and problems arising soon after construction was completed.

Cropping patterns in the study sites changed little after HPSIS; the dramatic changes had already occurred following Sederhana. Increased water availability in the dry season did enable farmers to plant rice three times per year. Farm management practices introduced during HPSIS have been sustained.

Conclusions

The study team reached the following conclusions about innovations introduced during project implementation:

- P3As created in the systems examined have not been sustained. With a single exception, the government-sponsored farmer organizations did not continue much beyond project implementation or other PU efforts. The exception is the P3A in a Lombok system, developed by Sederhana, where no irrigation had been conducted previously and no farmer organizations existed.

- Although P3As have not been sustained at the field level, the GOI has held to the position that P3As are needed and are a critical part of irrigation management efforts. Although the nature of the CO effort is still to be determined, GOI commitment to the concept has been sustained.

- Farmer investment in both main and tertiary systems continues, despite government policy that farmers are responsible only for O&M of the tertiary system. In areas where there are PU staffing constraints, farmers have continued to play a key and sometimes determining role in the operation of the main system.

- PU and PRIS interest in and commitment to small-scale irrigation has been sustained: PRIS is a continuing and important presence in the systems examined. Sederhana marked the government's first intervention in small-scale irrigation, and during the ensuing years, PRIS staff have continued to be involved in the systems,

regulating water delivery and supervising overall main system maintenance.

- The physical infrastructure of the systems examined has largely been sustained, although perhaps not at the level expected or desired by PRIS staff. Still, all of the systems are in operation despite the condition of individual structures.

- Farm management practices introduced by HPSIS have been sustained, even though their link to improved water management has continued to be inadequate.

Examination of the long-term impact of Sederhana and HPSIS Projects revealed the persistence of indigenous institutions despite significant government interventions to introduce new organizations. These organizations (*subaks* in Lombok) and leaders (*ulu-ulus* in West Java) have continued their roles in irrigation management. Those roles may have changed in some cases, but they have not been marginalized despite government attempts to replace them.

The findings suggest that where indigenous organizations and leaders were active prior to project implementation or other government efforts, they have continued and retain their importance. However, where they were already weak and were being replaced, as was the case with the *mandor jene* and *mandor uwae* on South Sulawesi, it was village government and not the P3A that filled the void and took on the added responsibility of managing the irrigation system.

With respect to irrigation management, privatization is generally defined in terms of the transfer of system ownership to water users. Thus far, the GOI has not expanded its turnover policy (the transfer of O&M management responsibilities to farmers) to include their actual ownership of the physical assets. This reassessment of the Sederhana and HPSIS experiences indicates farmers' capacity to fully operate and maintain the tertiary system and to draw upon their own resources to operate the main system as well when PRIS cannot.

Recommendations

GOI investment in small-scale irrigation systems should be concentrated in water-scarce systems where water distribution is a problem. In systems with water sufficiency and availability, the government should consider limiting investment to main system development and rehabilitation. In systems where water is sufficient but unevenly distributed, permitting only wet season cultivation, as in the SulSel study sites, the GOI should focus on O&M and drainage to avoid floods.

Designs for system development and rehabilitation should be made by PU and farmers working together. Farmers should be included in initial field inspections and plan reviews and should have an inspection role during construction.

Where there are strong, traditional irrigation organizations or leaders, the GOI should work through them rather than creating new entities or drafting new leaders. If there are no existing indigenous groups or leaders, the GOI should determine why none exist and whether they are needed. Major institutional interventions, such as the introduction of new local organizations, should be recognized as requiring long periods of time and scarce financial resources. These interventions should be considered only when no other alternatives exist.

The structure and organization of new water users groups should be defined by provincial or district authorities. The GOI should commit resources at the provincial and district levels to design, implement, and monitor a water users program.

To make the water users group more viable—

- The COs should first visit all farmers individually to explain the objectives and

functions of the P3A before calling a general meeting.

- The members should decide among themselves how they would like the water users group organized, what leadership positions the group needs, and what the members' responsibilities should be.

- Leaders should be elected by the members instead of being selected by the *kepala desa* or other influential villagers.

- The water users group should have sole authority over water allocation in the tertiary system.

- Main system water distribution should be scheduled cooperatively by the *juru pengairan* and representatives of the water users group.

- Training for group leaders should emphasize organization and administrative capabilities and water management practices.

- The CO function should be continued, but the GOI should recognize that the program will take time before it yields the desired benefits. The program will require constant monitoring and refinement before appropriate models are identified. The GOI should be prepared to commit itself to a long-term effort if the CO program is to be successful.

- The CO program needs to be better linked to the kabupaten. A permanent government employee in each *kabupaten* should be appointed as the program supervisor, coordinating CO programs and activities.

To increase the effectiveness of community organizers—

- Before undertaking any organizing activities, the CO and farmers should jointly identify priority problems in the system. This assessment will give the CO an opportunity to meet informally a wide range of water users in the system.

- The CO should also conduct many other tasks cooperatively, such as scheduling meetings among farmers and between farmers and PU officers and contractors, and training water group members.

RINGKASAN

Dalam bulan Mei 1990, USAID Jakarta meminta kepada ISPAN ("the Irrigation Support Project for Asia and the Near East") menyiapkan dan melaksanakan penilaian proyek Sistem Irigasi yagn sudah cukup lama ialah Sederhana I, Sederhana II, dan HPSIS ("High Performance Sederhana and Irrigation System"). Kegiatan proyek tersebut dilaksanakan dari tahun 1975 sampai dengan 1985 melalui Departemen PU dan Departemen Pertanian R.I.

Pemerintah Indonesia dan USAID menganggap proyek Sederana dan HPSIS sebagai usaha semifinal dalam membantu pengembangan irigasi berskala kecil, terutama melalui investasi prasarana fisik, perkenalan Perkumpulan Petani Pemakai Air (P3A), dan penggunaan CO ("community organizer") bekerja dengan petani dan memantapkan keberadaan perkumpulan yang baru dibentuk itu. Sederhana I adalah intervensi pertama Pemerintah dalam sistem irigasi kecil. Sampai dengan saat diperkenalkan perkumpulan itu irigasi kecil, sebagai sistem yang luasnya kurang dari 2000 hektar, dikelola secara eksklusif oleh petani.

Kajian ini dirancang untuk menentukan apakah ketiga proyek itu, Sederhana I, II, dan HPSIS telah lestari dalam hal-hal pengorganisasian, pelaksanaan teknis-engineering, dan pertanian sejak pelaksanaannya tahun 1975 sd 1985. Penilaian dilakukan dengan mengidentifikasikan faktor-faktor pendukung atau yang menghambat kelestarian dari satuan-satuan proyek itu.

Fokus studi adalah swastanisasi, disamping kelestarian, mencerminkan suatu perhatian apakah petani dalam mengoperasi sistem menunjukkan adanya peningkatan kemampuan mengelola sejak proyek berakhir, sehingga mendorong pemerintah untuk melakukan kegiatan penyerahan irigasi kecil kepada pengelolaan masyarakat.

Studi Terapan Irigasi Sederhana merupakan awal dari evaluasi proyek tahap akhir dimana didalamnya mengungkap tentang dampak proyek setelah berlangsung cukup lama : Irigasi Sederhana dan HPSIS telah diselesaikan sejak 5 - 10 tahun lalu. Studi ini, yang menekankan pada situasi apa adanya dari suatu sistem ketimbang spesifikasi-spesifikasi implementasi proyek, bukan dimaksudkan untuk menilai bantuan teknis yang telah diberikan maupun menilai upaya-upaya kerjasama pemerintah.

Sederhana

Proyek Sederhana merupakan investasi langsung yang pertama dari pemerintah dalam perbaikan, penyelesaian dan pembangunan saluran primer dan blok tersier pada sistem irigasi kecil. Irigasi sederhana sebetulnya tidak menggunakan pendekatan partisipatif yang melibatkan Kepala Desa dan organisasi pemakai air dalam sistem pembangunannya. Lokasi Proyek Sederhana ditentukan oleh staf dari PRIS, biasanya pada tingkat kabupaten. Perencanaan dan pembangunan sistem irigasi tersebut berlangsung tanpa keterlibatan pamong desa. Tidak ada tokoh irigasi tradisional yang diajak berunding tentang rencana pembangunan tersebut baik menyangkut lokasi, ukuran maupun sistem saluran serta fasilitas irigasi pada tahap perencanaan proyek. Rancangan yang telah dibuat kemudian disampaikan kepada PU Pusat untuk mendapatkan persetujuan dan hanya beberapa dari padanya yang pernah dintujukkan kepada petani.

Sesudah penyelesaian pembangunan pada setiap lokasi, tanggung jawab untuk saluran primer dipindahkan dari petani kepada PU. Dua staf dari PU, pengamat bendung dan penjaga pintu mengoperasikan dan memelihara saluran primer (Pengamat pintu air membuka dan menutup pintu air dan mengatur aliran air dari bendungan, penjaga

pintu air membuka dan menutup pintu pembagi atau saluran pembuangan serta memelihara saluran primer). Kebanyakan pengamat bendung dan penjaga pintu air adalah petani dari jaringan irigasi tersebut.

Dinas Pertanian Tingkat I memperkenalkan varitas padi dan palawija unggul serta mendemonstrasi penggunaan pupuk, tetapi tidak ada kegiatan khusus dalam bidang pertanian atau usahatani yang diintroduksi dibawah Proyek Sederhana. Oleh karena fokus proyek ini hanya pada perbaikan bangungan irigasi dan kurang memperhatikan partisipasi petani, maka proyek sederhana sering dicirikan sebagai proyek tanpa tujuan pengembangan institusional. Walaupun secara jelas memang ada beberapa kelompok petani dipimpin tokoh yang ada, sedikit upaya kerjasama telah dilakukan dengan dan melalui mereka. Akibatnya, petani tidak ikut berpartisipasi dalam kegiatan perencanaan atau pelaksanaan sistem tersebut. Tidak ada upaya yang dilakukan untuk merencanakan atau membuat kesepakatan dalam memperbaiki jadual pengoperasian dan pemeliharaan, sebagai hasil dari perbaikan sarana fisik. Belum ada upaya yang dilakukan untuk pembangunan fisik infrastruktur dengan secara simultan memperkenalkan P3A atau inovasi organisasi lainnya.

Namun demikian, Irigasi Sederhana sungguh memperkenalkan perubahan yang nyata terhadap kelembagaan yang ada. Melalui proyek Sederhana, PU untuk pertama kalinya menentukan keberadaan dan tanggung jawabnya dalam hal O&P saluran utama, yang sebelumnya dilakukan oleh aparat desa atau ketua kelompok tani yang ditunjuk. Dalam beberapa kasus, tanggung jawab ini dialihkan kepada aparat desa dari pada ke PU.

Pengalihan tanggung jawab ini menunjukkan perubahan yang nyata dalam cara pengoperaasian sistem daripada upaya-upaya pemerintah yang kurang berhasil dalam membentuk P3A yang diinginkan seragam di semua tempat. Pengalihan tanggung jawab atas saluran primer kepada PRIS tidak hanya memperlemah peranan aparat desa dan petani, tetapi juga tanpa disadari melemahkan upaya-upaya organisasi P3A, karena dalam sistem yang baru tersebut petani hanya memiliki kekuasaan yang lebih kecil dibanding dengan dalam pengaturan-pengaturan tradisional. Akibatnya P3A menjadi kurang menarik bagi petani.

Dampak yang segera timbul dan dramatis dari Proyek Sederhana adalah adanya introduksi padi gadu. Petani tidak hanya terbatas lagi pada menanam palawija. Untuk sebagian besar lokasi proyek, areal irigasi aktual untuk tanaman padi di musim hujan meningkat dari sekali tanam per tahun menjadi dua kali (padi- padi), dan pada beberapa kasus juga ditanam palawija sekali setahun (padi-padi-palawija).

Sejak proyek berakhir, pola tanam petani tidak berubah secara nyata. Walaupun demikian intensitas tanam meningkat karena penggunaan input produksi yang lebih baik, perbaikan teknik bercocok tanam dan peningkatan ketersediaan air irigasi untuk pertumbuhan padi dan palawija selama musim kemarau.

HPSIS

HPSIS menghasilkan kecil sekali, itupun jika ada, pengaruh institusional jangka panjang pada sistem-sistem irigasi yang dikaji. Meskipun pemerintah dalam beberapa tahun telah berusaha untuk menciptakan dan melestarikan manajemen baru dalam sistem HPSIS, petani secara jelas menunjukkan keengganan mereka untuk berpartisipasi dan untuk melestarikan P3A dalam waktu yang cukup lama setelah motivator (CO) ditempatkan. Setelah implementasi proyek, tidak ada rapat-rapat dan kegiatan-kegiatan berarti dari P3A. P3A tidak memungut iuran, dan petugas tidak mendapatkan gaji atau honor. Administrasi P3A menjadi terbengkalai atau tidak aktif, yang ada hanya buku tamu yang sewaktu-waktu diisi bila ada tamu datang ke kantor P3A. Kantor-kantor ini, kenyataannya masih ada sejak implementasi proyek HPSIS, tidak berperan aktif.

Pengenalan CO ("Community Organizer") sebagai katalis pengorganisasian masyarakat dalam upaya-upaya P3A, merupakan intervensi yang asli dan khas dari proyek HPSIS. CO diharapkan berfungsi merubah wajah dari program ini, untuk menunjukkan kesepakatan PU terhadap perubahan institusional pada tingkat sistem irigasi (proyek). Namun demikian, begitu CO meninggalkan sistem, petani segera kembali kepada cara pengaturan sebelumnya atau melakukan penyesuaian dengan melepaskan tanggungjawabnya dan menyerahkannya kepada desa atau aparat desa.

Petani kembali pada cara pengaturan sebelumnya untuk mengelola O&P terutama pada saluran tersier. Keterlibatan PU dalam pengembangan irigasi kecil dan pengelolaan saluran primer yang dimulai lebih awal dari berlangsungnya Proyek Sederhana, ternyata lebih lestari. Pola pembagian tanggung jawab di antara petani, aparat desa dengan pemerintah sungguh telah merupakan kebiasaan dalam sistem tersebut : pembagian tanggung jawab secara menyeluruh untuk O&P di saluran primer dan tersier telah ditangani dengan mantap. Pola ini tampak nyata pada lokasi Proyek Sederhana, sehingga sulit untuk menyatakan apa sumbangan dari proyek HPSIS. Petani pada sepuluh sistem irigasi itu juga melanjutkan partisipasinya dalam O&P saluran primer.

Dampak yang paling berpengaruh dari HPSIS dalam jangka panjang adalah pada pola pemikiran pejabat-pejabat PU di tingkat pusat maupun propinsi. Pada waktu HPSIS pertama kali dirancang dan dilaksanakan, program CO merupakan suatu pendekatan eksperimental untuk menjaring partisipasi petani yang lebih besar dalam O&P. Sekarang ini program tersebut telah cukup menunjukkan kepada PU bahwa fungsi CO harus merupakan bagian integral dari pengembangan irigasi skala kecil di kemudian hari. Isu yang berkembang kemudian adalah siapa yang paling tepat ddalam jajaran pemerintahan untuk melaksanakan peranan dan fungsi tersebut, tetapi kebutuhan dan efektivitas dari peranan dan fungsi CO sudah tidak dipertanyakan lagi.

HPSIS lebih menekankan perbaikan sistem manajemen dibanding pembangunan prasarana fisik, kecuali bila dalam sistem irigasi tersebut saluran primer yang permanen masih belum ada. Ketersediaan air irigasi untuk musim kemarau di lokasi proyek masih mengecewakan petani, disebabkan oleh kurang baiknya pemilihan lokasi proyek pada awalnya serta masalah yang timbul setelah pembangunan diselesaikan.

Pola tanam di lokasi studi menunjukkan perubahan yang kecil setelah adanya HPSIS; perubahan dramatis telah terjadi sejak dari Proyek Sederhana. Meningkatnya ketersediaan air pada musim kemarau telah memungkinkan petani untuk menanam padi 3 kali dalam setahun. Kebiasaan-kebiasaan pengelolaan usahatani yang diperkenalkan selama proyek HPSIS menunjukkan kelesatariannnya.

KESIMPULAN

Tim Kajian ini mengambil kesimpulan-kesimpulan berikut tentang invoasi yang diperkenalkan selama proyek berlangsung:

- P3A yang dibentuk di dalam sistem yang dikaji ternyata tidak lestari, setelah pelaksanaan implementasi proyek atau setelah usaha PU lainnya. Kekecualian ditemui pada satu sistem, P3A di Lombok yang dikembangkan melalui Proyek Sederhana, dimana sebelumnya belum pernah ada irigasi dan juga sebelumnya tidak ada organisasi petani yang dapat bersaing dengannya.

- Meskipun di lapang, gan, P3A diamati tidak lestari, tetapi pemerintah menempatkan kebijaksanaan pada posisi dimana P3A diperlukan dan merupakan bagian kritis dari usaha pengelolaan sistem irigasi. Walaupun penjabaran mengenai fungsi CO sedang ditentukan, kesepakatan pemerintah terhadap konsep ini tetap berlanjut.

- Investasi petani pada kedua sistem primer dan tersier tetap berlanjut, sekalipun kebijakan pemerintah menetapkan bahwa petani hanya bertanggungjawab terhadap O&P saluran tersier. Di daerah dimana ketersediaan petugas PU merupakan kendala, petani tetap harus melanjutkan memainkan peranan kuci dan menentukan di dalam operasi sistem primer.

- Perhatian dan kesepakatan PU dan PRIS terhadap sistem irigasi kecil tetap lestari: kehadiran PRIS berlanjut ada dalam sistem yang diteliti. Sederhana menandakan proyek pertama dimana pemerintah turun-tangan dalam Irigasi kecil dan dalam tahun-tahun terakhir, staf PRIS tetap dilibatkan dalam sistem tersebut, pengaturan penyaluran air dan mengawasi perbaikan keseluruhan sistem saluran primer.

- Prasarana fisik pada sistem yang dikaji pada umumnya tetap lestari, walaupun mungkin tidak memenuhi tingkat teknis yang diharapkan staf PRIS. Bahkan semua sistem masih beroprasi sekalipun keadaan strukturnya beragam satu dengan lainnya.

- Kebiasaan-kebiasaan pengelolaan usahatani yang diperkenalkan oleh HPSIS masih tetap lestari, meskipun kaitan teknisnya dalam meningkatkan pengelolaan air tetap tidak jelas.

Penelaahan atas dampak jangka panjang Proyek Sederhana dan HPSIS menunjukkan adanya ketahanan kelembagaan tradisional sekalipun pemerintah melakukan intervensi dalam memperkenalkan organisasi baru. Organisasi semacam ini, Subak di Lombok dan Ulu-ulu di Jawa, tetap melanjutkan peran mereka dalam mengelola air irigasi. Peran tersebut mungkin telah menunjukkan perubahan-perubahan di beberapa kasus, akan tetapi tidak dapat dipudarkan meskipun pemerintah telah mencoba untuk menggantinya.

Beberapa temuan menunjukkan bahwa bilamana organisasi asli dan pemimpin (tradisional) itu aktif sebelum pelaksanaan proyek atau sebelum campur tangan pemerintah, mereka tetap melanjutkan peranannya. Betapapun, bila peranan mereka telah melemah dan akan diganti, seperti pada kasus Mandor Jene dan Mandor Uwae di Sulawesi Selatan, peran institusi tradisional ini diambil oleh aparat desa dan bukan P3A yang mengisi kekosongan dan mengambil alih tanggung jawab atas pengelolaan sistem irigasi.

Berkenaan dengan pengelolaan irigasi, swastanisasi biasanya didefinisikan dalam arti pengalihan kepemilikan sistem kepada pengguna air. Sebegitu jauh, pemerintah tidak melanjutkan kebijakan pengalihan tanggungjawab pengelolaan O&P kepada petani yang termasuk kepemilikan langsung dari aset fisik sistem tersebut. Kajian terhadap pengalaman Sederhana dan HPSIS ini memperlihatkan kapasitas petani dalam mengoperasikan dan memelihara jaringan tersier secara penuh dan memanfaatkan sumberdaya mereka sendiri untuk melakukan juga pengelolaan jaringan primer bila PRIS tidak dapat melakukannya.

REKOMENDASI

Investasi pemerintah dalam sistem Irigasi Kecil seharusnya dikonsentrasikan pada sistem dimana fasilitas air terbatas, dan distribusi air merupakan suatu masalah. Pada sistem dimana keter-sediaan air cukup, pemerintah sebaiknya membatasi investasinya hanya pada pembangunan dan pemeliharaan saluran primer. Pada sistem dimana air tidak tersedia atau tidak mencukupi untuk merata, dimana penanaman hanya pada musim hujan, seperti halnya di lokasi-lokasi proyek Sulawesi Selatan pemerintah sebaiknya menitik beratkan pada O&P dan drainase untuk menghindari banjir dari pada membangun konstruksi.

Rancangan pengembangan sistem dan rehabilitasi harus dibuat oleh PU bekerjasama dengan petani.

Petani harus dilibatkan dalam pemeriksaan pendahuluan dan pemeriksaan ulang di lapangan, dalam pecancangan, serta dalam pengawasan selama pembangunan.

Dimana terdapat tokoh masyarakat atau organisasi petani tradisional yang kuat, seyogyanya pemerintah bekerjasama dengan mereka daripada menciptakan sesuatu lembaga atau pemimpin yang baru. Bila disana mereka tidak ada, pemerintah terlebih dahulu harus mengkaji, mengapa mereka tidak ada dan kemudian menentukan kebutuhannya. Campur tangan kelembagaan yang utama seperti introduksi organisasi baru, harus disadari sebagai sesuatu yang membutuhkan waktu investasi jangka panjang dan kelangkaan dana. Campur tangan baru dipertimbangkan hanya bila tidak ada jalan keluar lainnya.

Struktur dan organisasi kelompok petani pemakai air sebaiknya diatur dan ditentukan oleh para pengambil keputusan dan pengelola di tingkat propinsi atau kabupaten. Pemerintah harus percaya sepenuhnya terhadap pihak yang berkompeten di tingkat propinsi dan kabupaten untuk merencanakan, melaksa-nakan, dan memonitor program petani pengguna air.

Untuk menumbuhkan kelompok pemakai air berperan serta lebih aktif, perlu diperhatikan hal-hal berikut:

- Sebelum mengadakan pertemuan dengan seluruh petani pemakai air, CO sebaiknya terlebih dahulu mengunjungi beberapa orang petani guna menjelaskan maksud dan tujuan serta fungsi (manfaat) diadakannya kelompok P3A tersebut, sebelum diadakan pertemuan yang lebih meluas.

- Anggota kelompok sebaiknya berperan serta secara aktif dalam hal menentukan model/sistem organisasi, posisi kepemimpinan atau pengurus yang dikehendaki serta hak dan tanggung jawab anggota dalam organisasi tersebut.

- Tokoh-tokoh pemimpin kelompok dipilih oleh anggota daripada mereka yang sebelumnya telah diseleksi oleh Kepala Desa atau tokoh/sesepuh masyarakat.

- Setiap kelompok pemakai air perlu memiliki/mendapatkan kewenangan dalam mengatur pembagian air untuk tingkat tersier.

- Sistem pembagian air di saluran utama harus dijadual dan dikerjakan secara bersama-sama antara juru pengairan dengan para wakil kelompok petani pemakai air.

- Pelatihan untuk tokoh-tokoh pemimpin kelompok sebaiknya lebih memprioritaskan kemampuan, organisasi dan administrasi serta praktek manajemen pengairan.

- Fungsi CO harus dilanjutkan, tetapi pemerintah perlu menyadari untuk mencapai keberhasilan pemantapan fungsi tersebut dibutuhkan waktu yang relatif lama. Program CO membutuhkan suatu usaha pembinaan yang rutin dan intensip terutama dalam hal pengawasan dan ikhtiar perbaikan selanjutnya. Untuk itu perlu diidentifikasi dicarikan satu model monitoring dan penyelesaian yang teridentifikasi. Jika program CO ingin berhasil, pemerintah harus siap untuk melaksanakannya dalam jangka panjang.

- Program CO ini sebaiknya lebih banyak terkait dengan pemerintah kabupaten. Setiap kabupaten sudah saatnya memiliki/mengangkat pegawai negeri tetap sebagai supervisor program, mengkoordinasi program CO dan semua kegiatannya.

Disarankan agar CO:

- Sebelum menjalankan pengorganisasian kegiatannya, CO bersama-sama dengan para petani mengidentifikasi masalah utama yang terdapat di jaringan irigasi tersebut. Hal ini akan memberikan kesempatan pada CO dalam mengatur pertemuan-pertemuan informal dengan petani pemakai air.
- CO juga harus mengerjakan beberapa kegiatan secara bersama-sama dengan petani antara lain : membuat jadwal pertemuan antara petani dengan CO; petani dengan petugas PU; petani dengan kontraktor pelaksana dan jadual kegiatan training dan pelatihan bagi anggota kelompok.

1

BACKGROUND AND PURPOSE

Background

In May 1989, the U.S. Agency for International Development (USAID) in Jakarta requested that the Irrigation Support Project for Asia and the Near East (ISPAN) design and conduct a reassessment of USAID's long-concluded Sederhana I, Sederhana II, and High Performance Sederhana Irrigation Systems (HPSIS) Projects. These three projects were implemented from 1975 to 1985 through the Indonesian Ministry of Public Works (PU) and the Ministry of Agriculture (MOA).

The Government of Indonesia (GOI) and USAID regard the Sederhana and HPSIS Projects as seminal efforts to aid small-scale irrigation development, particularly through physical infrastructure investment, introduction of the water users association (*Perkumpulan Petani Pemakai Air* or P3A), and use of the community organizer (CO) to work directly with farmers and enhance the viability of the newly created associations. Sederhana I was the GOI's first intervention in small-scale irrigation systems. Until that time, small-scale systems—defined as those having fewer than 2,000 hectares—had been managed exclusively by farmers.

The reassessment study was designed to determine the extent to which the three projects have been sustained in organizational, technical, and agricultural terms and to identify factors that have supported or impeded sustainability at the project sites. In addition to assessing community organizer efforts and water users associations, the study examines a number of current policy issues related to small-scale irrigation development, including system turnover and irrigation fees.

The study's focus on privatization, in addition to sustainability, reflects an interest in determining whether the way farmers are operating systems since project termination indicates their improved capacity to manage the systems, thus supports the Government of Indonesia's (GOI) present system turnover activities.

The GOI is pursuing some of the most innovative irrigation development programs in Asia. According to the current five-year plan or Repelita V (1989/90-1993/94), government policy calls for the P3As to assume management of all irrigation systems of fewer than 500 hectares. System turnover is now being implemented in projects throughout Java and in West Nusa Tenggara (NTB), South Sulawesi (SulSel), and West Sumatra. The turnover program is being undertaken with technical assistance from the Institute for Economic and Social Research, Education, and Information (LP3ES), an experienced Indonesian nongovernmental organization. It has been given responsibility for dealing with the social and economic aspects of turnover and for training government field officers and community organizers (TP4s). Funding is provided by the Ford Foundation.

In a separate effort, with assistance from the World Bank, the GOI is also instituting a program of irrigation service fees (ISF) in Java's three provinces and in SulSel. The pilot projects are restricted to systems of greater than 500 hectares. A locally instituted irrigation fee (IPEP) was introduced in SulSel by the governor in 1988 and covers all systems in the provinces.

Funding for this study was provided through the Special Studies Program of the Small-Scale

Irrigation Management Project (SSIMP) currently being implemented in three provinces: West Nusa Tenggara, South Sulawesi, and also East Nusa Tenggara (NTT), whose sites are exclusively groundwater.

This reassessment of the Sederhana and HPSIS Projects is one of a growing number of applied studies that the Irrigation Support Project for Asia and the Near East (ISPAN) has conducted for USAID missions and host governments in Asia and the Near East.

Objectives

The study's major purpose is to understand the current situation in the former Sederhana and HPSIS sites with regard to several elements:

- organizational arrangements and processes through which the systems are sustained
- operation and maintenance of the physical systems
- agricultural production activities
- pattern of investment in the irrigation system, both local and external, since project completion

The study is intended to provide information directly relevant and applicable to SSIMP's efforts in developing the physical infrastructure and strengthening water users associations. It is also expected that the results will offer insights into current issues in small-scale irrigation development policy:

- waters users associations
- system turnover
- community organizers
- irrigation service fees
- physical infrastructure investment
- on-farm management, including cropping patterns and cropping intensities

Approach

The Sederhana Applied Study is a departure from final project evaluations in that it explores project impact after a considerable length of time has elapsed: Sederhana and HPSIS ended from five to ten years ago. The study, which emphasizes the current situation in the systems rather than the specifics of project implementation, is not meant to be an evaluation of technical assistance provided or of GOI collaborative efforts.

In June 1989, the study was initiated with a short-term consultancy by Dr. E. Walter Coward, Jr. of Cornell University, who prepared the scope of work. The study design limited data collection to 20 sites, 10 Sederhana and 10 HPSIS in West Java (JaBar), NTB, and SulSel. NTB and SulSel were selected because they are provinces of SSIMP implementation. West Java was included because it was the major recipient of Sederhana Project support; more than 12 percent of the project systems are in West Java. The 10 HPSIS sites represent the total universe of HPSIS systems in those provinces; Sederhana systems were selected in the same districts.

The study was designed to be carried out by an Indonesian consulting firm with the assistance of an expatriate consultant who would make three visits at strategic times during the six-month period. The scope of work, after its approval by the Ministry of Public Works (PU) and USAID, was circulated to seven Indonesian consulting firms in an ISPAN request for proposals. Five firms submitted proposals to ISPAN, and Pusat Pengembangan Agribisnis (PPA) was selected.

Substantive work began with a one-week team planning meeting in mid-December 1989 attended by PPA's professional study team: an irrigation

engineer, agronomist, sociologist, study administrator, and field coordinator. Dr. Coward and Dr. Peter Reiss, ISPAN Deputy Director, also participated. At the planning meeting, team members discussed the study background and objectives, data requirements, methodology, fieldwork schedule, individual responsibilities, and administrative issues. The Indonesian team members also arranged for a visit to a nonstudy site in West Java for a demonstration walk-through in January. Briefings were provided to PU and USAID at the end of the week.

Following the walk-through and an effort to channel data requirements into composite questions, the professional team trained four field assistants to collect data at the West Java HPSIS and Sederhana sites. The field assistants collected data in pairs as they moved from site to site, residing in each site for two weeks. At each site, the field assistants worked under the supervision of a field coordinator, who was to monitor their progress regularly. Data collection began in mid-April, following their one-week training.

The design called for the project assistants to prepare a case study report at each site, but a review of the four West Java reports showed them to be of limited use. Because field assistants reduced their data-collection time in order to prepare the reports before moving on to the next site, the case study requirement was deleted from the scope of work with USAID and PU agreement.

In late June, additional field assistants joined the team, and four teams worked simultaneously in NTB (Lombok) and SulSel. Two weeks later, the senior team (including the expatriate consultant and study administrator) met with all the field assistants in Lombok for a nine-day intensive training program, focusing particularly on the study's institutional and social data requirements. Because simultaneous data collection in two provinces made supervision too problematical, the field assistants were reduced to six and worked only on Lombok. The field coordinator position was restructured at that time, also. Senior team members were assigned a much more significant role in the supervision of the field assistants and began a program of regular site visits, so that at least one senior team member was with the field assistants each week.

On 30 July, data collection resumed in Lombok and extended through 27 August for eight systems. The field assistants then moved to South Sulawesi at the beginning of September and completed data collection in eight systems by mid-October. They returned to the four West Java sites from 20 October to 1 November so that the data collected there would be more comparable to those of NTB and SulSel. November through mid-December was spent analyzing data and preparing the study report, and the study concluded with a team presentation to USAID and PU on 14 December 1990.

Data Collected

A reassessment of the long-term impact of the Sederhana and HPSIS Projects required data about preproject and postproject situations in each of the systems investigated. Thus, for each of the 20 systems basic data were collected concerning the administrative location, water source, location on the river, period of implementation, activities, and cost of Sederhana and HPSIS interventions. Other background data collected included material on the pre-Sederhana/HPSIS situations—technical facilities, hectarage irrigated, cropping patterns, and organizational arrangements for irrigation.

For all significant structures from the diversion structure through the distribution system, whether government or farmer built, data were collected regarding present condition and use. Those structures not in operation were noted, and information on the rehabilitation of broken structures was taken. At each site, the team also recorded the current and design hectarage for wet and dry seasons.

Data were collected on the cropping patterns at the head, middle, and tail sections of each system. A

detailed crop calendar for each system was also prepared, and estimates of major wet- and dry-season crops were collected from farmers in the systems and agricultural extension agents (PPL). Production inputs were recorded, as well.

Information on the institutional arrangements among farmers and with the government, whether formal or informal, was recorded. Data focused on the actual operations of the P3A and any indigenous or other government-sponsored entity responsible for water distribution and system maintenance.

The investment history of each system since the completion of the projects was recorded, including both government and farmer contributions in cash or in kind. Farmer contributions might be made through the P3A or another entity. Government contributions were recorded according to the kind of assistance provided, the agency, the period, and the cost.

Methodology

The field assistants collected data for this report from government officers and farmers, using interview guides. The study team deliberately chose not to design and carry out an extensive survey, as previous studies of Sederhana and HPSIS (see Robinson reports) had demonstrated the limitations of this methodology whereby significant correlations between factors could be ascertained but not explained. The study team chose to focus on process and change, depending upon more open-ended interviews to provide insights and explanations of why project interventions were or were not sustained.

Data collection began in each system with a walk-through of the entire irrigation system by the field assistants and the local PU officer. For every structure, the field assistants recorded its location and state, canal condition, crops being grown, and system-level patterns of water rotation.

During the remainder of the two weeks at the site, the field assistants interviewed a variety of government officers and farmers, including the local PU officer, the gate keeper, the village and subvillage leaders, the village farmer group and the P3A, water masters, and water users.

Agricultural data were collected, in part, through a brief questionnaire responded to by nine farmers in each of the 20 systems, three each at the head, middle, and tail.

Team Composition

The study was implemented through PPA and administered by its Managing Director, Dr. Mohamad Amin Aziz. The Indonesian senior professional staff included Dr. Ir. Soedodo Hardjoamidjojo, Associate Professor of Agricultural Engineering at the Bogor Agricultural University (IPB); Ir. Sutarwi Surowinoto, Associate Professor of Agronomy, also at IPB; and Dr. Richard Hutapea, Associate Professor of Sociology at Satya Wacana University in Salatiga.

Dr. Peter Reiss, ISPAN Deputy Director, visited Indonesia five times during the course of study: at the initial team planning meeting; midterm for four weeks to help retrain the field assistants and monitor progress with senior research staff; for five weeks, to take part in the data analysis, report writing, and presentations to USAID and PU; for two weeks to complete the final draft; and finally to join the other team members in discussions of the final draft with PU and USAID in May 1991.

PPA supplied six field assistants: Drs. Mirza Fauzi, Ir. Satrio Budi Handoko, Ir. Sutjahjo, Ir. Widhiastoto, Drs. Maksudi, and Drs. Saleh Djunaidi. The first four continued on past the fieldwork to assist with data analysis.

2

SMALL-SCALE IRRIGATION DEVELOPMENT IN INDONESIA

Overview of Small-Scale and Simple Irrigation

Irrigation systems in Indonesia are characterized by the GOI and donors according to command area, technological level, or entity responsible for system management. Systems are classified as small, medium, or large by command area size; simple, semi-technical, or technical by level of technology. They are managed by PU, by farmers, or both. Donors most frequently classify irrigation systems by size, while the GOI primarily considers the level of technology.

Prior to 1985, small-scale irrigation systems were defined as those of fewer than 2,000 hectares; medium-scale range was from 2,000 to 5,000 hectares; and large-scale systems were greater than 5,000 hectares. Small-scale systems are now considered to have fewer than 500 hectares, the current ceiling for system turnover. Irrigation in Indonesia is predominately small scale; approximately 60 percent of the irrigated paddy fields (*sawah*) are served by small systems (USAID 1985). The preponderance of small schemes in Indonesia relates directly to the topography of the major islands whose volcanic spines lead to many small rivers, as compared with huge rivers on the plains of other Asian countries (Varley 1989).

Irrigation is managed by PU on 83 percent of the country's irrigated service area, which totals about 5.4 million hectares. Of this area, probably two-thirds is in small-scale irrigation. These systems were designed and built by PU, and are partially operated and maintained by that ministry. The remaining irrigation, 17 percent, is in village systems that are generally small-scale and cover about 1,037,000 hectares. These systems (*irigasi desa*), designed and built by landowners and water users, are now operated by them. Although the systems are farmer developed and managed, they may receive public assistance of various kinds, including village subsidies.

A system's technological level is primarily the basis of GOI classifications and determinations of investment and involvement. The level depends both upon the physical structures and upon responsibility for water allocation and distribution. Simple systems (*irigasi sederhana*) have few permanent intakes or distribution structures. In village systems, channels may be used for both water distribution and drainage. Water is used by farmers without government interference. Construction, management, and maintenance are carried out and funded by the community and the local government.

Semi-technical systems have permanent canals but few control and measuring structures except at the headworks. The source and, occasionally, the primary canal and key structures are controlled by the government, but farmers manage water distribution and some system maintenance. Roughly 27 percent of all systems are semi-technical.

Technical systems, which have permanent canals, control structures, and measuring devices, are constructed and maintained by PU. All tertiary and on-farm systems are managed by farmers and PU and supervised by the village government.

Village systems are likely to be small-scale and simple, and large-scale systems are likely to the technical. However, roughly 50 percent of Indonesia's total irrigated area is served by technical systems and 60 percent by small-scale systems; thus, there is clearly some overlap of those categories.

Small-scale systems are not necessarily technically simple.

Policy Issues

The GOI currently faces a number of important policy issues concerning small-scale irrigation development. They all relate in some way to the shifting roles and responsibilities of government agencies and farmers in the development, management, and maintenance of these systems.

Physical Infrastructure Development

Before Sederhana, the government's policy in small-scale irrigation was to mobilize funds from farmers, with the government providing funds only to stimulate farmer contributions. With Pelita II and Sederhana, the government made direct investments in infrastructure development of small-scale systems in the main and tertiary systems. These investments supported the development of new systems or the completion and improvement of existing ones. After completion, the government transferred management to the Provincial Irrigation Service (PRIS), which required continuing long-term commitment and responsibility.

More recently, the GOI has been less willing to make substantial investments in small-scale irrigation due to budgetary constraints. Its achievement of rice self-sufficiency, which reduced the urgency for more production, may also have led Indonesia to shift priorities. In Repelita V, the development of the irrigation subsector was shifted to the operation and maintenance (O&M) of existing systems, the completion only of priority ongoing projects, and the continuing development of tertiary and quaternary schemes, rather than the further development of new irrigation systems.

As a result, the GOI has placed a premium on improving the O&M of existing irrigation systems by enhancing the capability of local institutions, i.e., water users associations, to take on increased or sole responsibility for system operation. At present, the provincial irrigation service is responsible for O&M at the tertiary off-take and above; farmers are responsible, through their P3As, for O&M below this level.

In 1990-91, the GOI estimated an Rp. 30,000 per hectare cost for adequate O&M on the entire PU-managed area, assuming that the systems are in a minimum state of repair and efficient methods are applied. Most systems, however, require rehabilitation to reach this condition. It has been suggested that even Rp. 50,000 per hectare would be inadequate where no criteria for assessing O&M standards exist. The term "efficient O&M" has been used in project context to indicate a program of training, institution-building, and new financing mechanisms.

Water Users Associations

Indonesia has a long history of farmer-managed irrigation systems. In many locations in the country, indigenous irrigation groups have carried out complex water management arrangements and supported intensive agricultural patterns within the limits of the water supply (USAID 1985). The centuries-old *subaks* of Bali have an important place in anthropological literature (Geertz 1967, 1972, 1980) as examples of both ritual group and joint-property groups responsible for the upkeep and operation of hydraulic works. Neighboring Lombok has its own form of subak. West Java and South Sulawesi maintain a tradition of village government responsibility for local irrigation affairs, administered through an irrigation official appointed by the village headman.

When it established a water users program in 1975, the GOI chose to bypass these traditional entities for three major reasons. First, the government program had already built irrigation systems that superseded the old village system, believing these indigenous irrigation groups to be no longer a viable institutional resource. Second, the boundaries of the new systems frequently were larger than the previous village systems or cut across old boundaries. Finally, there was the perception that

the indigenous groups were inefficient and inequitable. As one observer wrote, "It should not be assumed that all traditional water users associations demonstrate the sophistication and charm of the Balinese subak" (Morfit 1983a). However, he did allow that little was known about them.

Presidential Instruction No. 2 in 1984 delineated the organizational structure of the P3A and defined its executive committee: chairman, deputy chairman, secretary, treasurer, and water master. The P3A is responsible for managing irrigation and groundwater use at the tertiary level, for determining the fees required to manage the system, and for guiding members in following government rules.

The typical P3A, with 100 to 200 members, operates in an area of about 70 to 200 hectares. Some P3As were organized along administrative or village rather than hydrological boundaries, sometimes causing the association to inadequately cover tertiary systems. The GOI is presently reorganizing these older P3As, as well as newer ones, along hydrologic boundaries.

Creation and viability of the P3As has been disappointing. They should be operational in every tertiary system, but only 65 percent of the tertiaries in the areas identified for special maintenance have been developed. Of the P3As established, an estimated 15 percent are active, 20 percent are semiactive, and the balance are inactive (IBRD 1987). Despite these disappointments, recent GOI policies to support O&M and cost recovery have designated the P3A as responsible for O&M activities on tertiary systems. P3A members may also share the costs and responsibilities for O&M on the main systems.

The implementation of these policies requires a realistic approach to P3A development, increased decision-making by farmers in system design, and improved coordination between P3As and agency field staff (IBRD 1987). The present status of the indigenous irrigation groups should also be explored. Their continued activity, despite years of government investment in and attention to P3As, suggests that, where they exist, the government might implement its policies through these entities while elsewhere developing a more effective approach to P3As.

Questions still remain: What will be the responsibilities of irrigation groups? What role will they play in collecting and using irrigation service fees? What skills do farmers and local government officials need to carry out government policy? What further training will they require?

System Turnover

As a way of stemming mounting recurrent costs for O&M, the GOI is presently turning over responsibility for managing small-scale irrigation systems to farmers. According to a government policy statement in 1987, all government-managed irrigation systems of fewer than 500 hectares should be turned over to water user associations.

Preparation for turnover activities (PIK) began in 1987 in West Java and West Sumatra. With support from the Ford Foundation, activities focused exclusively on systems of less than 150 hectares, with the exception of a few larger systems to test the approach in systems between 150 and 500 hectares. In 1988, PIK implementation was absorbed into the IBRD Irrigation Subsector Project (ISSP), although funding from Ford continued to LP3ES for CO training and supervision and to the International Irrigation Management Institute (IIMI) to monitor the program implementation. LP3ES has been active in the training and field coordination of social and institutional aspects for PRIS officers. In 1988-89, activities expanded into districts in Central Java and Yogyakarta. At present, 112 systems are targeted for turnover in West Java, 15 in Central Java, 45 in Yogyakarta, and 128 in West Sumatra. The systems range from 12 to 500 hectares (LP3ES 1989).

These systems fall into three types. In Type A systems with good physical infrastructure and where O&M responsibilities are clearly defined, no special

maintenance is undertaken, but the inventory book is revised. In Type B systems with good physical infrastructure but where P3As are not functioning, COs are posted to provide guidance to farmers. Type C systems without a satisfactory physical infrastructure are assisted in efforts to create P3As, and special maintenance is provided.

P3As are not yet legal entities, and their future status is under discussion. In 1988, a policy study concerning the legal underpinnings of the P3A found that a legal basis does exist for them to be treated as nonprofit, legal bodies, once they have been registered by the district government. LP3ES (1989) argues that there is also a legal basis for transferring responsibility for irrigation system O&M and assets, including structures, to P3As. It is certain that the turnover of public property will also involve higher levels of government, including the finance department. As such, the transfer of assets is being treated separately from the turnover of O&M responsibility, perhaps to the detriment of the program.

Important policy issues now under discussion concern the roles that PU should turn over to farmers. Turnover policy intends to shift the burden of maintenance onto farmers, but what is to be their responsibility in system operation? Another issue concerns whether system size should be the critical criterion for selecting systems to be turned over.

Community Organizers

Community organizers were introduced under HPSIS in 1980, and implemented in 1981-82 by MOA and in 1982-83 by PU to encourage farmer participation and facilitate P3A formation. Organizers are now a part of three ongoing donor projects: Small-Scale Irrigation Management Project, Irrigation Subsector Project, and the Third Irrigation Sector Project (TISP). The first, a USAID-sponsored project, has contracted with LP3ES for the design and implementation of what it calls water user association organizers (WUAOs). The latter two focus particularly on establishing irrigation service fee and turnover programs and carry out their own training. The irrigation service fee program uses field assistants and the turnover program uses TP4s. These community organizers work in a system for 24 months. They speak the local dialect and are paid by the projects.

Although the GOI appears to have decided to continue and expand the use of COs working with farmers, a number of policy issues remain. Community organizers are still used only within the context of finite donor projects; the GOI has yet to make them a permanent feature of irrigation systems development. Nor are there recurrent costs for CO activities. PU has decided informally that COs are to be in the systems working with farmers prior to start of construction, although there is considerable variation among the programs and among systems. The GOI is increasingly aware of the need for individual strategies in response to regional differences.

A number of responsibilities have been identified for COs. They may serve purely as community organizers, participate in technical surveys and design activities, or serve as liaisons between the farmers and the government. PU appears to have decided that COs henceforth will be recruited from government cadres.

Irrigation Service Fees

Traditionally, farmers throughout Indonesia regularly contributed to the costs of irrigation management in ways agreed to among themselves. They paid irrigation leaders measures of unhusked rice seasonally and in some parts of Java paid for each turn of water. In the 1970s, the GOI intervened to formalize these service fees.

Indonesia's formal irrigation fee program was introduced in Tajum irrigation system in Central Java in 1972. The fee was 200 kg. of rice/ha/year, and the program lasted two years. In 1982, another fee program was initiated in the Sadang irrigation system in South Sulawesi. An irrigation charge of Rp. 5,000 per hectare per season was expanded to the entire province in 1988 to support the O&M

budget. A small fee of Rp. 1,000 per hectare per year is being collected with other village taxes in Simalungun irrigation system in North Sumatra, and a fee is also collected in Bali (IBRD 1987). All of these programs appear to be locally designed and implemented.

In other initiatives, the GOI in 1989 introduced irrigation service fees through TISP, ISSP, and IISP (Integrated Irrigation Sector Project); all three are mandated to operate in irrigation systems of more than 500 hectares. ISF is considered an instrument to resolve such water management issues as water allocation and distribution, system maintenance, conflict resolution, and financial management.

The IBRD Irrigation Subsector Project (ISSP), operating in several locations in West, Central, and East Java and in SulSel, covers about 55,000 hectares. In 1991-92, the program will expand into Yogyakarta, Lampung, and West Sumatra and will cover 700,000 hectares by 1994-95. The Asian Development Bank-funded TISP now uses the same model employed by ISSP in North Sumatra and will possibly expand into Aceh and Maluku. The more recent IISP, also funded by ADB, will be implemented in a number of locations in Central Java, West Sumatra, Yogyakarta, and Southeast Sulawesi.

These projects focus on the creation of P3As as ISF collectors and on the clear definition of local government role in improving water management agreements among P3A groups and in instituting proper financial and administrative measures. During the first year of fee collection on Java and SulSel, the collection efficiencies ranged from 60 to 100 percent, averaging 80 percent.

Under discussion are the use of farmer payment capacity as the basis for setting an appropriate fee amount and the organizational arrangements needed for the collection (IBRD 1987). ISSP has recently factored the level of service into the fee.

Overview of the Sederhana Projects

Sederhana I

The Sederhana Reclamation and Irrigation Program was initiated in 1974 by the Government of Indonesia as a rapid and inexpensive way to increase food production throughout the country. The program, part of Repelita II (1974-79), was to improve existing irrigation structures and extend irrigation into new areas. It was funded at $35.5 million out of government coffers. In June 1975, USAID signed a loan agreement with the GOI, augmenting project funding by $20 million. The funding was later increased to $23.7 million. The funds were to offset local construction costs, provide training for GOI personnel, finance vehicle procurement, and provide technical assistance (Holloran 1982).

Sederhana I stressed the importance of village irrigation systems and focused on the renovation or construction of simple irrigation systems with commands of 2,000 or fewer hectares. In a significant divergence from previous projects, Sederhana was implemented in 23 of Indonesia's 26 provinces, bringing resources to the sometimes neglected outer islands. A total of 550,000 hectares were targeted for development and by 1978, when Sederhana I terminated, roughly 240,000 had been improved. Nearly 80 percent of these were on the outer islands off Java and Madura (Robinson 1984b).

An early evaluation of Sederhana I (Gray et al. 1978) found that the systems were clearly helping to increase Indonesia's rice output and enhance the incomes of several hundred thousand farm families, nearly all of whom were cultivating less than one hectare of paddy. Benefits arose largely because of a shift from rain-fed to irrigated rice cultivation and from single-cropping of irrigated rice to double-cropping. It also cited the strengthening of GOI and village institutional capacity to develop simple irrigation systems.

Despite the successes of Sederhana I, the project suffered from a number of weaknesses. There was insufficient participation by farmers in decisions regarding the design and construction of major works. Construction quality needed to be monitored more closely. Although the systems were to be constructed quickly, the GOI decided to construct many of them in separate segments, and some systems took as long as four years to completion. Delays were caused by inadequate GOI budget allocations and the MOA's limited ability to administer construction activities due to budgetary and manpower constraints.

Sederhana II

In 1978, Sederhana II was signed between USAID and the GOI as a $25 million loan and $4.5 million grant. The project was designed to continue and extend the work of Sederhana I; an additional $6.8 million was obligated in 1980. By the project's termination in 1983, Sederhana I and II had built or rehabilitated approximately 980 small-scale irrigation systems on about 400,000 hectares (Robinson 1984b). Small-scale system development had also been undertaken by the GOI apart from the USAID-funded projects. More than 1,800 systems of fewer than 2,000 hectares were constructed or rehabilitated in all.

In Sederhana I, the PU was responsible for main system improvements and construction. The MOA primarily developed the tertiary systems, water users associations, and extension training programs. A significant change for the project was a transfer from MOA to PU in 1979 of lead responsibility for all tertiary canal construction, in addition to responsibility for the main system. However, PU did not begin designing tertiary canals as part of the whole system until 1979-80 (USAID 1980).

Overall assessments of the Sederhana experience indicate positive gains: the projects built a large number of systems over a wide area; the systems, built relatively quickly, brought a large amount of land under cultivation and improved water reliability during the wet and dry seasons in areas where there was some irrigation prior to the projects.

A number of shortcomings were also apparent (Robinson 1986). Systems suffered from poor design and location. In some locations, the water source was inadequate for the area, so that less land was irrigated than had been designed. Some systems had nonfunctioning structures. Some turnouts did not work, and some canals were improperly located, did not hold water, or were washed out. Diversion weirs were often improperly located and poorly built. Structures were found to have been destroyed or altered by farmers; "unofficial" turnouts or canals were sometimes constructed by farmers, who deliberately destroyed turnouts and measuring devices. Some canals in the main and tertiary systems were full of silt and weeds.

Government and farmer responsibility for both main and tertiary systems maintenance was never clearly defined. Canals fell apart without being rebuilt, with farmers claiming that the government was responsible for repairs. The government, on the other hand, claimed farmers were to make repairs and blamed them for the damages. Systems were poorly operated. Some farmers claimed they received insufficient water, while others got more than necessary. Water was stolen or taken out of turn. Then, too, harvests and yields were lower than expected.

A number of explanations have been offered for these failures. One focuses on the centralization of decision-making about small-scale irrigation: all decisions about site selection and other important matters were made in the central offices. Another focuses on the lack of farmer participation in decision-making. (Robinson 1984c). The third concerns poor site selection and poor system design (P.T. EXSA 1986 and Gerards 1990b).

High Performance Sederhana Irrigation Systems Project

The High Performance Sederhana Irrigation Systems Project (HPSIS) was designed to address

Sederhana weaknesses, particularly in the enhancement of local participation. The purpose of HPSIS was to test and refine a participatory approach to developing and managing small-scale irrigation systems. In April 1982, HPSIS began in 14 systems although the agreement formally creating the project was signed in August 1983. An additional 7 sites were added to the project in January 1984, making 21 sites spread over eight provinces. All HPSIS activities ended in December 1985.

HPSIS was funded by the GOI with $1.07 million, USAID with $1.4 million in loan funds and $2.12 million as a grant, and the Ford Foundation with $119,000. Activities in the sites were implemented through the MOA and PU. Of the 21 sites, 6 were supervised by MOA and 15 by PU; all were monitored by provincial and district teams of the two agencies. When HPSIS was being designed, PU was responsible for main system construction and rehabilitation only, and MOA was responsible for the tertiary system and for organizing farmers. In 1979, when PU responsibility was expanded to construction in the entire system, tertiary water management and water users associations remained with MOA. The old division between the agencies was reflected in the division of project sites (Robinson 1986).

Project sites represented three levels of physical infrastructure completeness. The first were called "system development (SD) sites" because project activities focused on construction rather than management. They were the least physically developed of the systems. At these sites, both main and tertiary works were designed and developed with the farmers' active participation. Originally three, one was later absorbed into the second category; these sites were under PU.

The second type, with partially completed systems, were called "system development and management (SDM) sites." These systems had completed and functioning major works but no official tertiary system. Activities were construction and management. The tertiary facilities were designed and constructed with farmer participation. There were 11 of these sites, shared by PU and MOA.

Sites with physically complete main and tertiary systems were the third type. These seven "system management (SM) sites" had no planned construction under HPSIS. Farmers participated not in the design and construction of the physical system, but only in the operation and maintenance of the irrigation system already in place. Here inputs were largely institutional. These sites were all under the MOA.

HPSIS focused on a small package of interventions largely carried out in all 21 sites: using community organizers, collecting benchmark and evaluation data, monitoring project implementation at the sites, training farmers and local government staff, and constructing the system. Under HPSIS all main system structures were designed to be permanent, unlike Sederhana, which constructed semipermanent structures like gabions. Tertiary system construction under HPSIS was identical to that of Sederhana.

The most innovative HPSIS approach was the introduction of COs, operating through the P3A, to work with farmers in system development. Two or three community organizers were posted to each site for two years. In practice, one CO was responsible for roughly 75 to 100 hectares or about 150 to 200 farmers. At the end of the project, however, community organizers had no institutional home; they were neither government employees nor entirely of the private sector.

The CO role was expected to be both technical and nontechnical. However, as farmers increasingly relied upon the COs for technical information, CO training became more technical than was originally intended. COs formed working groups as P3A embryos to provide comments during the design phase and conduct initial meetings to explain the project and tertiary system design. COs served as mediators in disputes between working groups and contractors over wages paid during construction. They served as spokesmen for the P3As in requesting contractors to improve construction

quality. COs organized community groups in cooperative work (*gotong royong*) for system maintenance and repair. They created an organizational structure for the P3As and facilitated meetings for P3A formation and the selection of leaders. Finally, they acted as partisans of farmers in protesting the absence of promised trial runs of the system before regular operation (Dilts et al. 1988).

As envisioned by HPSIS, P3A members were to maintain the flow of water to the rice fields, maintain the physical system, use *gotong royong* to repair and clean canals and maintain irrigation structures, and contribute membership fees to the P3A. COs would assist in these efforts.

HPSIS convinced the GOI and USAID that the COs performed an essential function in helping to establish more open and reliable channels of communication between farmers and government officials (USAID 1985). A GOI-USAID follow-up project adapted the CO approach further.

Recent Efforts in Small-Scale Irrigation

The Small-Scale Irrigation Management Project is the next generation of support to small-scale systems. Sites actually extend into intermediate-scale systems, since they range from 970 to 3,500 hectares, although six of the nine sites have commands of fewer than 2,000 hectares. SSIMP is developing new surface systems in NTB and SulSel; other components focus on groundwater development. The agreement was signed for the eight-year project in August 1985, shortly before the completion of HPSIS.

The two most important SSIMP elements are its institutional-strengthening themes: decentralization of decision-making and beneficiary participation. Decentralization of decision-making is intended to strengthen the capacity of provincial staff to design and construct surface irrigation systems using local consultant contractors for the feasibility and design work. Beneficiary participation has the objective of ensuring effective operation and maintenance of systems. The designation of LP3ES as the lead entity in training and supervising community organizers and in creating P3As is a feature unique to the project.

The use of community organizers in SSIMP is a significant carry-over from HPSIS. COs come in roughly equal numbers from two sources: local government (provincial and kabupaten) ranks, where they are low-level cadre, and LP3ES, which recruits them from outside. The LP3ES contract with the GOI calls for it to train and supervise COs, in addition to supplying them. Each CO is assigned to 300-500 hectares, considerably higher than the HPSIS ratio, which was not thought to be cost-effective. COs on SSIMP will arrive at project sites six months preceding construction and remain there until at least a year after construction has been completed. A WUAO supervisor and provincial WUAO coordinator oversee CO activities.

3

STUDY SITES

Site Selection

Ten Sederhana and 10 HPSIS systems were selected for examination during this study. (See Figure 1 for location of study sites.) The 10 HPSIS systems in the study represent the total universe of project sites in West Java, West Nusa Tenggara, and South Sulawesi (see Figures 2-4). According to the design, the Sederhana sites were to be chosen from the same districts as the HPSIS sites to stimulate comparison and ease logistical requirements. The construction at half of the Sederhana study sites was to have been completed prior to 1980. In each province, there was to be one site with more than 500 hectares and one identified by PRIS as having significant technical and/or organizational problems. In fact, the year 1980 appears to have been somewhat arbitrarily chosen as the halfway point of the three Sederhana efforts. A more pertinent date would have been 1978, the year Sederhana II began and PU was given responsibility for both main and tertiary system construction. The 500-hectare break is treated with some flexibility because most of the Sederhana sites were well under 500 hectares. For study purposes, those with nearly that command size (i.e., Sindang Gila with 495 and Sidemen with 470) have been placed in the over-500 category.

The selection process varied widely among districts. In some, potential sites were reviewed and selected or eliminated as unsuitable according to the established criteria. In others, however, PRIS urged the selection of particular sites because of agency experiences in the systems. Thus, the choice of study sites was often more personal than criteria-based.

Two Sederhana sites in Cianjur and Pandeglang districts in West Java were selected collaboratively by USAID staff and PRIS officers. PRIS suggested that all turnover pilot project sites be eliminated from the study because PIK intervention would detract from the identification of long-term Sederhana impact. As a result, none were chosen in any of the three study provinces. In all, Cianjur had 10 Sederhana sites. Four were also PIK sites, and one was already selected as a HPSIS site. Two of

Table 1

Selection Categories of Sederhana Study Sites

	Actual Irrigated Area	
Sederhana	<500 ha	>500 ha
I	Leuwi Jubleg (JaBar) Cibojongkakak (JaBar) Ireng Daya (NTB) Bulumarapa (SulSel)	Sidemen (NTB)
II	Rempek (NTB) Panyili (SulSel) Panaikang III (SulSel)	Sindang Gila (NTB) Biangloe V/VI (SulSel)

Figure 1

Indonesia

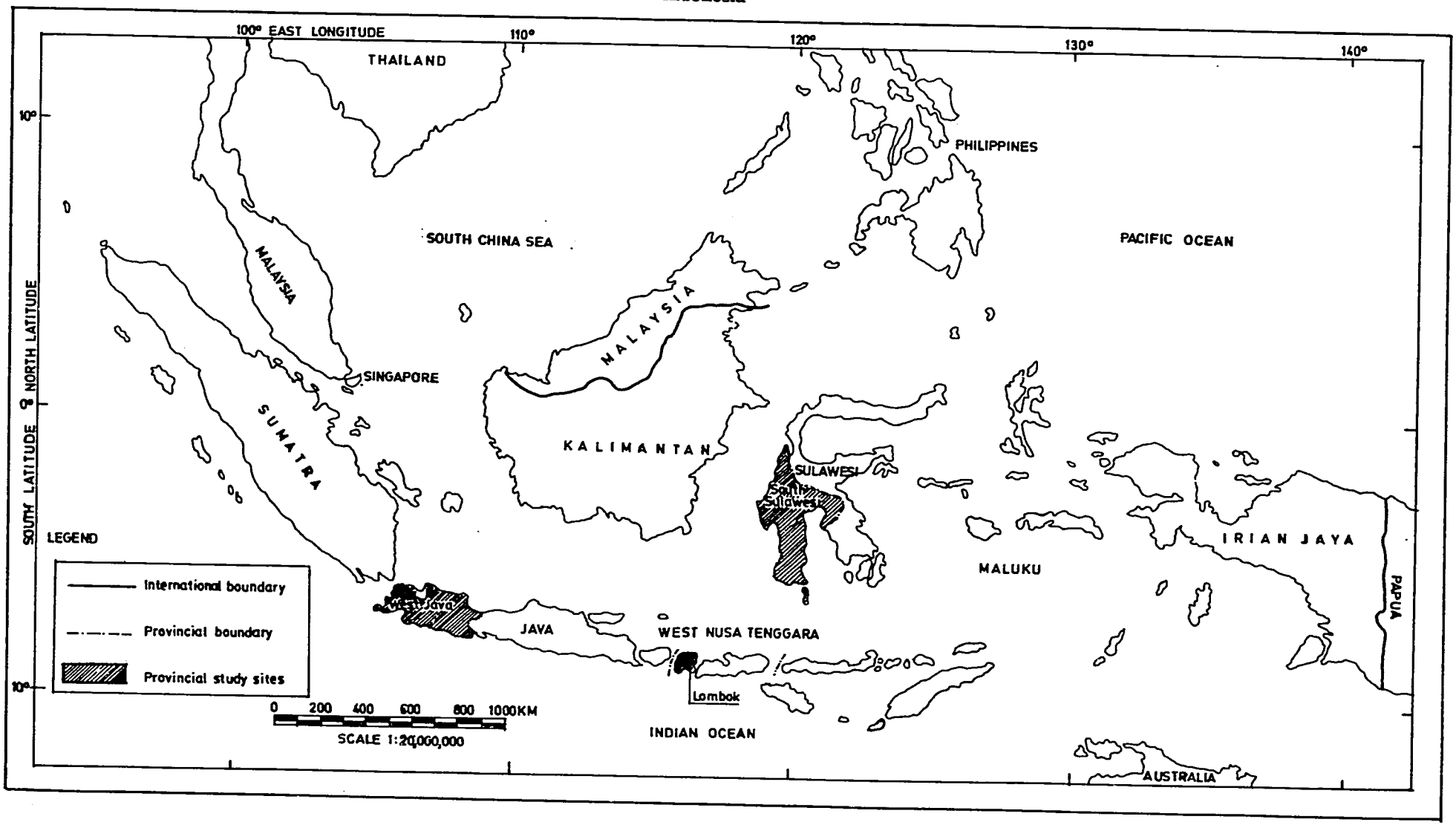


Figure 2

West Java Study Sites

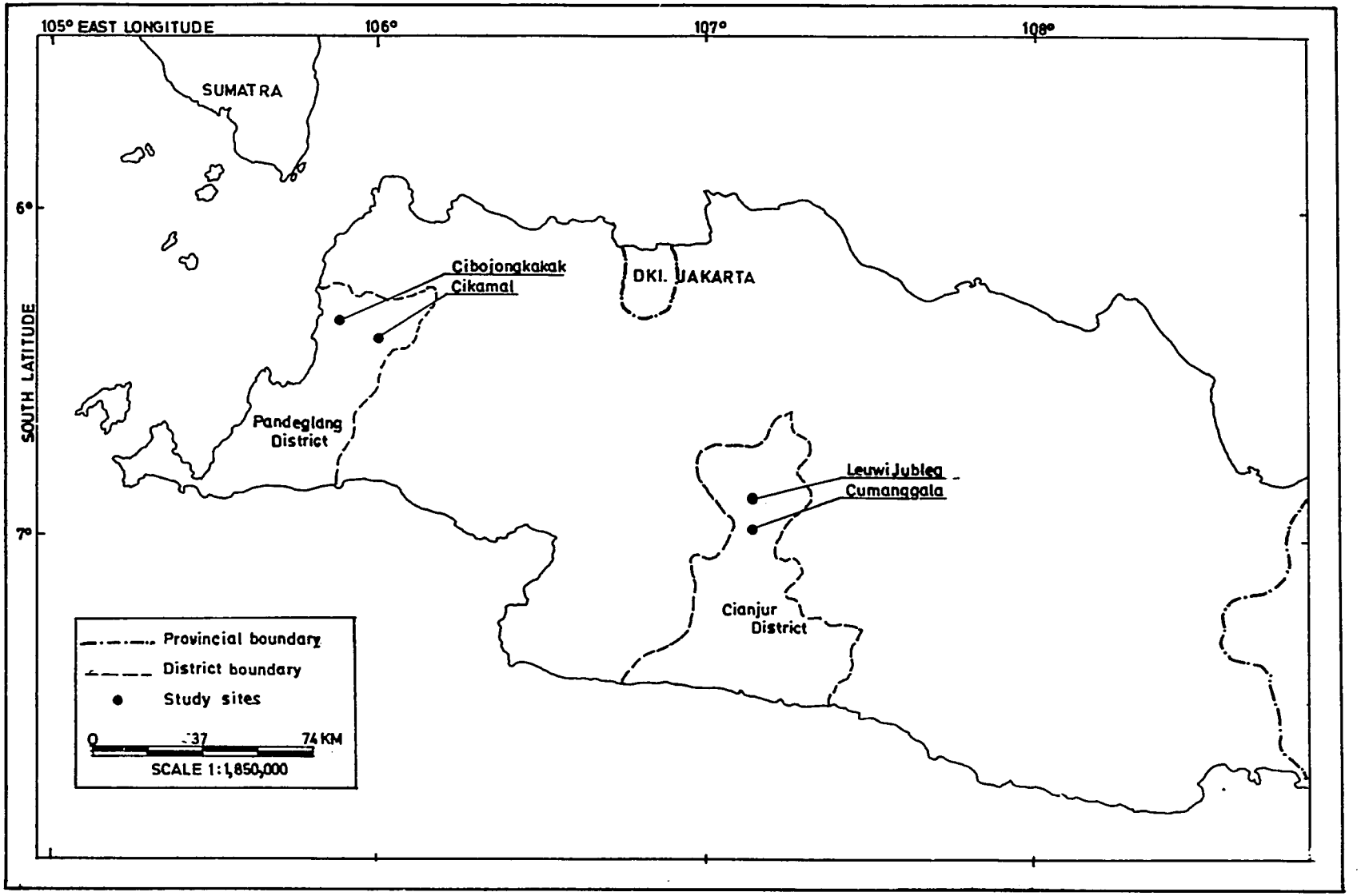


Figure 3

West Nusa Tenggaara Study Sites

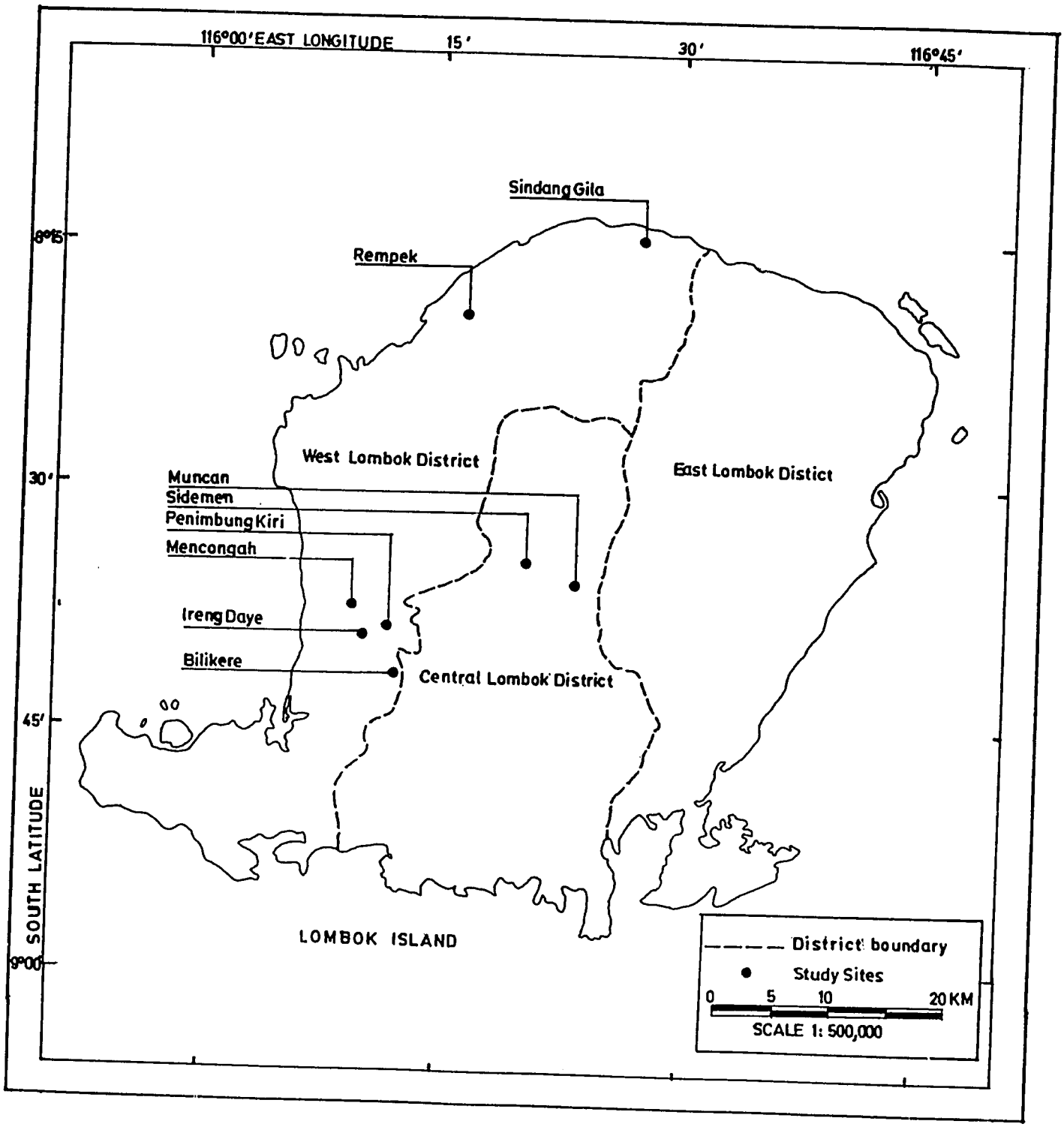
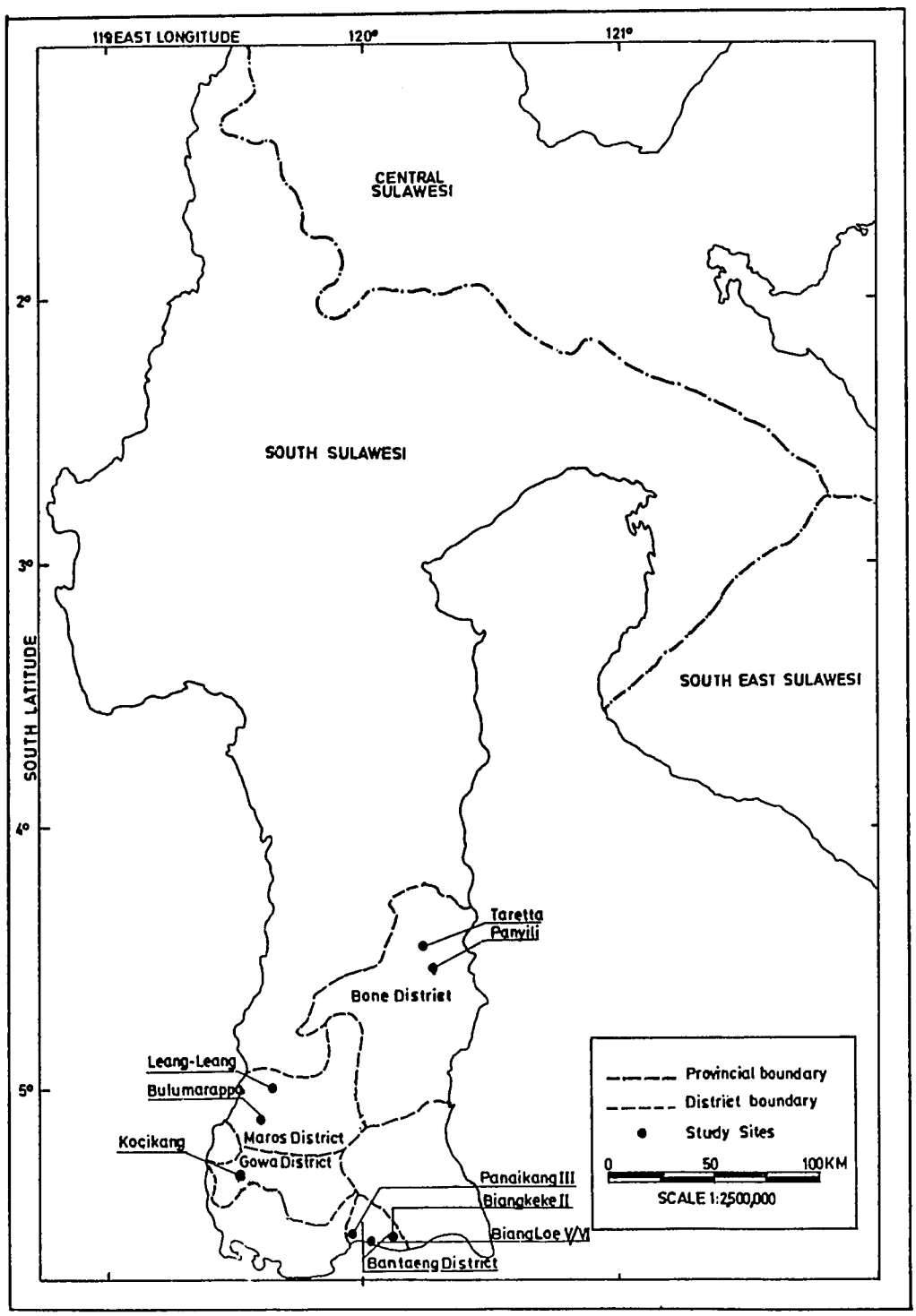


Figure 4

South Sulawesi Study Sites



the remaining five have unusually small command areas of less than 50 hectares, and in another, Sederhana had been implemented on only a portion of the service area. This left Leuwi Jubleg as the only suitable site: developed in 1982/83, it had fewer than 500 hectares and was described by PRIS as having had both organizational and technical pr ms.

There are 13 Sederhana sites in Pandeglang district. As a study site, PRIS suggested that Cibojongkakak, an unusual site in that the main system had a permanent dam before Sederhana rehabilitation. PRIS's interest stemmed from organizational problems: it had tried unsuccessfully to develop a water users association at Cibojongkakak.

In NTB, the four HPSIS systems were in West Lombok and Central Lombok. Seven Sederhana sites were in the former and five in the latter districts. PRIS officers suggested the study team visit seven sites before selecting the four that would become study sites. Those eventually chosen for the study were three in West Lombok and one in Central Lombok.

The four HPSIS systems in South Sulawesi are in four different districts: Bantaeng, Gowa, Maros, and Bone. A number of Sederhana sites in Bantaeng were already in the PIK program. Of the five remaining sites suggested by PRIS, two provided an interesting comparison: Biangloe V/VI, which was developed under Sederhana I and has more than 500 hectares, and Panaikang III, which was developed under Sederhana II and has fewer than 500 hectares. Both were selected. Sederhana sites in Gowa were excluded because of serious ongoing system damages. In Maros and Bone, PRIS and USAID staff suggested particular sites based on first-hand experience: Bulumarapa in Maros and Panyili in Bone were selected.

In the selection of study sites, meeting rigorous survey methods was less important than the USAID-PU collaborative effort, which was the first step in a process of understanding change and impact in system sites.

Province Characteristics

Geography and Population

West Java, one of five provinces on Indonesia's most populated and important island, encompasses roughly 2.5 percent of the total land mass of the country and has 19 percent of its population. In the north, West Java is dominated by lowland plains, and in the south by mountains. Most of the rice area in the north is irrigated from Jatiluhur Dam in the center of the province; intensive rice terraces dating back several centuries are found in the south. The province covers roughly 35 percent of Java's total area.

To the east of Java, just beyond Bali, lies West Nusa Tenggara, comprising the major islands of Lombok and Sumbawa. HPSIS was implemented only on Lombok, NTB's most western island, although Sederhana was carried out on Sumbawa also. Lombok accounts for 24 percent of the province's land and 72 percent of its population. Most people of Lombok live in the central plain, which is bordered by mountains to the north and dry, barren hills to the south.

South Sulawesi is the main population and communication center of eastern Indonesia. The province is dominated by a mountainous cordillera region, but its coastal lowlands surrounding the central highland area are the scene of SulSel's most fertile land.

West Java has by the far the largest population of the study provinces, over ten times the population of NTB and nearly five times the population of SulSel (Table 2). West Java also has a much higher population density than the other study provinces. NTB's population density is 91 per square kilometer, although on Lombok alone it is 166, greater than that of SulSel. The population density of the two districts with HPSIS sites is greater still: West Lombok's is 356 and Central Lombok's is 292. The largest of the island's districts, East Lombok, is more sparsely populated, and its density is roughly

Table 2

Area, Administrative Divisions, and Population of the Study Provinces

Province	Area (km)[2]	% of Total	Population[1]	Population Density[2]	Districts	Villages
JaBar	44,176	2.3	32,399,000	661	20	7,063
NTB	20,153	1.0	3,159,000	91	6	564
SulSel	62,482	3.2	6,832,000	148	21	1,405

[1] 1987 data
[2] 1987 data
Source: Statistical Yearbook of Indonesia, 1988.

equal to that of NTB as a whole, indicating that Sumbawa's is considerably lower.

All three provinces have a significant proportion of their populations involved in agricultural pursuits, anywhere from 45 to 62 percent (Table 3). However, the provinces differ widely in per capita income. West Java has a growing industrial base in steel, cement, and fabrics, which accounts in part for the higher per capita income there.

Table 3

Income Profile of JaBar, NTB, and SulSel

Province	% Pop. in Agriculture[1]	Per Capita Income[2] (Rp.)
JaBar	45.3	433,000
NTB	62.2	202,600
SulSel	59.5	313,500

[1] 1987 data
[2] 1986 data

Source: Statistical Yearbook of Indonesia, 1988.

The population of West Java is largely Sundanese, the second largest ethnic group after the Javanese, who are culturally and linguistically distinct. The population of Lombok is Sasak, believed originally to have migrated from northwest India or Burma. Although there are links to Bali, including a Balinese occupation of Lombok for a century and a half, the population is Muslim and distinctly different from the Balinese.

The people of South Sulawesi are members of four ethnic groups. The largest is the Bugis, with a population of over three million. They inhabit the central part of the SulSel peninsula, which includes the province's most fertile rice plains. Along the southern coast are the Makassarese, roughly 1.5 million people. The half-million Mandar are to the northwest. In equal number are the Toraja in the central massif. The study districts are exclusively Makassar (Gowa), exclusively Bugis (Bone), and mixed Makassar and Bugis (Bantaeng and Maros). Others in SulSel include Javanese and Balinese transmigrants based in Luwu and Polmas. SulSel's population has been overwhelmingly Muslim for three centuries, although the Toraja are predominately Christian and there are pockets of Hindus.

Land Use

While there is an overlap in land use in the three provinces, more specific land use is widely divergent (Table 4). West Java's greatest use of land is in wet- and dryland for field crops. On Lombok, land is used more for inland ponds and forests. In South Sulawesi, the largest areas of use are for dryland crops and forest.

Table 4

Economic Land Use in the Study Provinces
(000 ha)

Province	Wetland	Dryland	Pasture	Fishpond	Pond	Unused	Forest	Plantation
JaBar	1199.0	967.2	53.4	28.9	25.9	102.1	228.8	415.8
NTB	198.0	200.8	103.5	4.7	415.8	239.4	320.9	15.6
SulSel	580.6	805.4	365.8	365.8	.7	288.9	771.5	290.5

Source: Statistical Year Book of Indonesia, 1988.

Table 4 categories require some clarification. Wetlands are used for paddy, both irrigated and unirrigated; drylands are for uplands rice and *palawija*. Fishponds are on the coast areas, used for raising brackish water shrimp and milkfish; ponds are in upland areas for freshwater fish. Plantations in West Java are for tea, rubber, cocoa, coconuts. NTB has coffee and cocoa plantations. South Sulawesi plantations are planted in candlenuts, rubber, coconut, coffee, and cloves. Unused land is not yet developed and could be swamp or dryland.

Rainfall

In Indonesia, the wet season falls between October and March, and the dry season between April and September (Table 5). For agricultural purposes, a month with more than 200 mm rainfall is considered to be wet; one with less than 100 mm is dry; and a moist month falls between (Oldeman 1975). The minimum amount of rainfall required for rice without irrigation is 145 mm/month in the wet season and 200 mm/month in the dry. If the rainfall is less than 100 mm, corn, soybeans, groundnuts, mungbeans, and tobacco can be grown without irrigation. With 100 to 200 mm, upland rice can be grown.

Among the three provinces, rainfall is widely divergent. As a result, the period of wet season paddy cultivation varies: cultivation takes place from October through January in West Java, from December through March in NTB, and from November through February in the South Sulawesi study sites.

South Sulawesi has two dry months; West Java has only one. West Nusa Tenggara has seven months that are dry; all but one of these months have rainfall well below West Java's lowest.

Table 5

Average Monthly Rainfall in West Java, West Nusa Tenggara, and South Sulawesi
(1985-89)
(mm)

Month	JaBar	NTB	SulSel
January	299.8	271.8	450.7
February	455.3	235.4	309.1
March	292.7	220.3	225.9
April	232.9	92.9	204.7
May	141.8	76.9	233.4
June	125.6	77.8	136.9
July	118.0	34.7	108.5
August	83.0	34.8	109.9
September	156.4	35.5	60.7
October	214.1	49.4	82.1
November	283.6	192.1	229.4
December	268.5	184.6	343.5
Total	2671.7	1506.2	2495.1

Source: Provincial Departments of Public Works and Agriculture.

Wet season rainfall in Lombok permits rice growing in most of the island. Lombok has extensive rice

terraces, and many irrigation schemes have been constructed to provide supplemental water in the rainy season.

While the eastern and western coasts of South Sulawesi experience their wet seasons at different times of the year, both have long and exceptionally dry seasons.

Harvests, Yields, and Production

Wetland rice is the most important crop grown throughout Indonesia. It may be irrigated or unirrigated, grown in the wet season or the dry. Roughly 75 percent of the area devoted to wetland rice is irrigated. Ideally, the area planted in the wet season should be equal to that in the dry season, but in practice, far more land is planted in wetland rice during the wet season because in the dry seasons rivers are usually low, and there is less water in the system. Upland rice, planted only in the wet season, is mostly in varieties with a longer growing season.

For the GOI, the most important palawija crop is soybeans, to be grown as a commercial crop. In 1987, the government instituted a special intensification program to increase soybean production in order to reduce imports. For farmers, the most important palawija crop is maize, which is grown mostly for domestic consumption.

The most important nonfood palawija crop in the study provinces is tobacco. In West Java, the center of tobacco-growing is the south of the province, near Garut. In South Sulawesi, it is grown in Soppeng, in the center of the province. In both provinces, it is grown commercially. On Lombok, tobacco is largely grown for household use and is planted during the dry season in scattered small plots after wetland rice is harvested.

Overview of Study Sites

Project Models and Investment

Although 10 systems were chosen as Sederhana sites, 18 of the 20 study sites actually had Sederhana investment (Table 7). The infrastructure of eight of the HPSIS study sites was developed under Sederhana as the first instance of government

Table 6

Area Harvested, Yield, and Production of Food Crops (1986)

Crop	JaBar	NTB	SulSel	JaBar	NTB	SulSel	JaBar	NTB	SulSel
	Area harvested (000 ha)			Yield (QU/ha)[1]			Production (000 ton)		
Wetland rice	1937.8	231.8	666.4	45.3	39.6	40.6	8787.9	907.2	2707.6
Upland rice	144.2	14.9	19.5	20.9	17.1	17.9	149.4	25.5	34.9
Maize	123.6	24.1	314.1	18.8	17.2	15.5	232.3	41.4	486.6
Soybeans	88.7	92.5	34.8	9.4	9.8	10.2	83.5	90.7	35.5
Peanuts	87.2	15.4	53.4	10.9	12.7	12.2	95.9	19.5	65.1
Sweet potatoes	48.3	8.8	9.7	97.0	95.0	83.0	468.2	83.8	80.3
Cassava	151.3	11.2	36.8	121.0	106.0	118.0	1833.9	118.8	433.7

[1] QU=quintal or 100 kilograms

Source: Agricultural Survey Production of Cereals in Indonesia, Central Bureau of Statistics, 1986.

Table 7

Sederhana and HPSIS Arrangements and Investments in Study Sites

Site	Implementing Agency	Implementing Type	Total GOI and USAID Sederhana and HPSIS Investment (Rp.million)	Years Implemented	
				Sederhana	HPSIS
Sederhana					
West Java					
Leuwi Jubleg			45.0	1978-79	
				1982-83	
Cibojongkakak			12.8	1976-77	
West Nusa Tenggara					
Sindang Gila			358.0	1980-81	
Rempek			135.0	1979-80	
Ireng Daya			24.0	1976-77	
			10.0	1978-79	
Sidemen			40.0	1976-77	
			75.0	1978-79	
South Sulawesi					
Bulumarapa			27.7	1976-76	
Panyili			10.5	1976-77	
Panaikang III			68.1	1981-82	
Biangloe V/VI			50.0	1978-79	
HPSIS					
West Java					
Cumanggala	MOA	SM	64.4	1976-77	
				1977-78	1982-85
				1979-80	
Cikamal	MOA	SDM	81.5	1979-80	1982-84
West Nusa Tenggara					
Mencongah	MOA	SM	98.6	1979-80	1984-85
Muncan	PU	SD	303.7		1984-85
Bilikere	PU	SDM	152.4	1978-79	1984-85
Penimbung Kiri	MOA	SDM	34.3	1977-78	1982-85
				1978-79	
South Sulawesi					
Leang-Leang	MOA	SM	91.9	1977-78	
				1979-80	21982-85
				1981-82	
Kocikang	MOA	SDM	35.6	1975-76	1982-85
				1979-80	1983-84
Taretta	PU	SD	45.9		1984-85
Biangkeke II	PU	SDM	105.9	1979-80	

support. Sederhana was implemented over a nine-year period (1974-83) in two phases, and interventions were sometimes made on separate occasions and budgeted independently.

The report has discussed the organizational arrangements of HPSIS implementation. Responsibility for HPSIS at the sites was given to the MOA or PU; the former was the lead agency for 15 of the total 21 sites. In the study sites, MOA took the lead on six systems, PU on four.

HPSIS sites fell into three kinds of systems: system management, system development, and system

management and development. These reflect levels of infrastructure development and management requirements: the two SD systems required both main and tertiary system construction and rehabilitation; the five SDM systems were to have both tertiary system development and institutional support; the three SM systems were to have no system construction, only institutional interventions.

Land Operators and Landholdings

The study sites are fairly evenly divided between those in which landowners and sharecroppers are the predominate operators and those in which most of the operators are the landowners (Table 8). In general, landholdings in the 20 systems are comparable: nearly all are small, less than one

Table 8

Land Operators and Size of Landholdings in the Study Sites

Site	Land Operators (%)		Landholdings (%)			
	Owners	Share-croppers	<.26	.26-.50	.5-1.0	>1.0
Sederhana						
West Java						
Leuwi Jubleg	69	31	24	26	37	13
Cibojongkakak	25	75	15	10	59	16
West Nusa Tenggara						
Sindang Gila	65	35	16	40	42	2
Rempek	96	4	17	72	9	2
Ireng Daya	62	38	45	38	16	1
Sidemen	61	39	28	57	13	2
South Sulawesi						
Bulumarapa	68	32	14	21	47	18
Panyili	49	51	1	20	67	12
Panaikang III	44	56	23	55	21	1
Biangloe V/VI	43	57	13	11	68	8
HPSIS						
West Java						
Cumanggala	40	60	28	28	41	3
Cikamal	25	75	36	29	30	5
West Nusa Tenggara						
Mencongah	42	58	29	37	21	13
Muncan	43	57	24	65	10	1
Bilikere	27	73	27	33	22	18
Penimbung Kiri	64	36	43	38	16	3
South Sulawesi						
Leang-Leang	83	17	3	7	34	56
Kocikang	57	43	25	52	22	1
Taretta	44	56	12	10	63	15
Biangkeke II	49	51	46	40	14	0

hectare, and there are few instances of farmers owning more than two hectares. The anomaly is Leang-Leang, with more than half of its holdings greater than one hectare.

Water Sources and Rainfall

The rainfall data given in Figure 5 are the minimum and maximum monthly averages of five-year rainfall records. The systems in South Sulawesi, particularly Leang-Leang and Kocikang, vary more widely in their rainfall range than do the West Java and West Nusa Tenggara systems. Despite its variation, the total yearly rainfall in South Sulawesi is much higher than in West Java and West Nusa Tenggara.

For 18 of the study sites, rivers are the source of irrigation water. Water discharge from the rivers varies from 219 to 8,000 lps (maximum) and from 73 to 1,000 lps (minimum). For the Leang-Leang and Kocikang systems, the source of irrigation water is rainfed rivers. There is little water in those rivers during the dry season, however, because of unevenly distributed rainfall throughout the year. Only the Taretta and Panyili systems in South Sulawesi depend upon artesian wells, discharging 858 and 63 lps, respectively. Although the discharges are relatively small, they are constant throughout the year.

In terms of access to water resources, the 20 study sites can be classified according to water sufficiency and water availability. Water is "sufficient" if the average monthly rainfall is 200 mm or more; water is "available" if rainfall is evenly distributed throughout the year. For the purposes of this study, water sufficiency and availability have been calculated on the basis of two independent measures: average monthly rainfall (AMR) and rainfall distribution (RD), using the standard deviation of the monthly rainfall.

Data used for this purpose were the averages of monthly rainfall for the five-year period from 1985-89. The data are from the rainfall stations nearest to the sites.

Table 9 establishes a sliding scale for rating water sufficiency and water availability. Water sufficiency increases directly with rainfall: the lower the standard deviation, the more even the distribution and hence the availability. In Table 10, the 20 systems are rated according to a combination of their water sufficiency and availability.

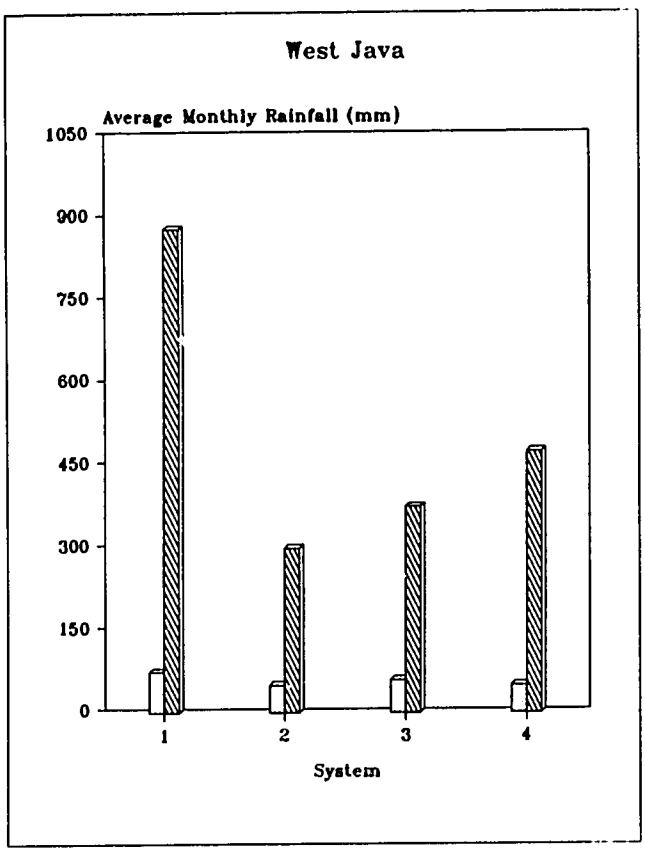
Table 9

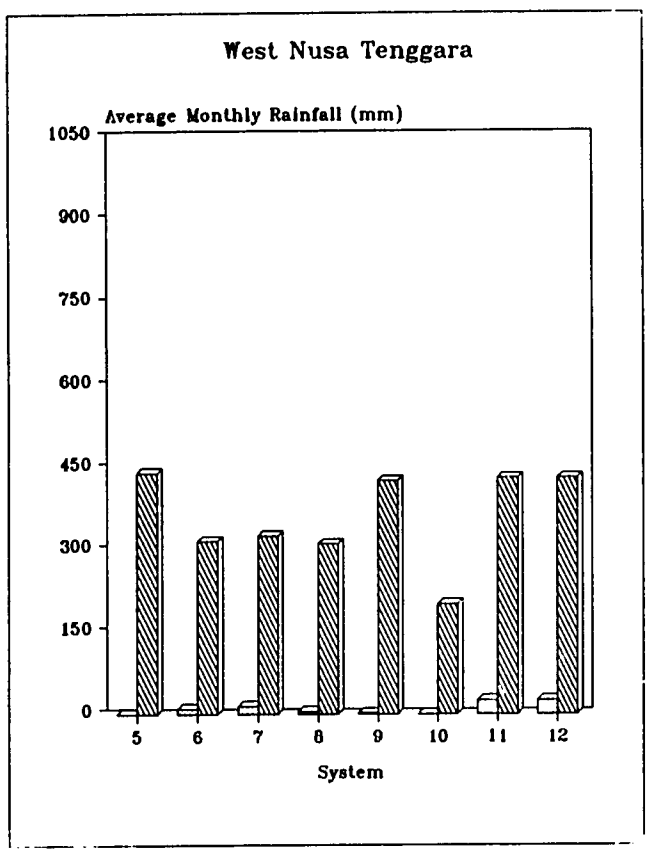
Classifying Average Monthly Rainfall and Rainfall Distribution

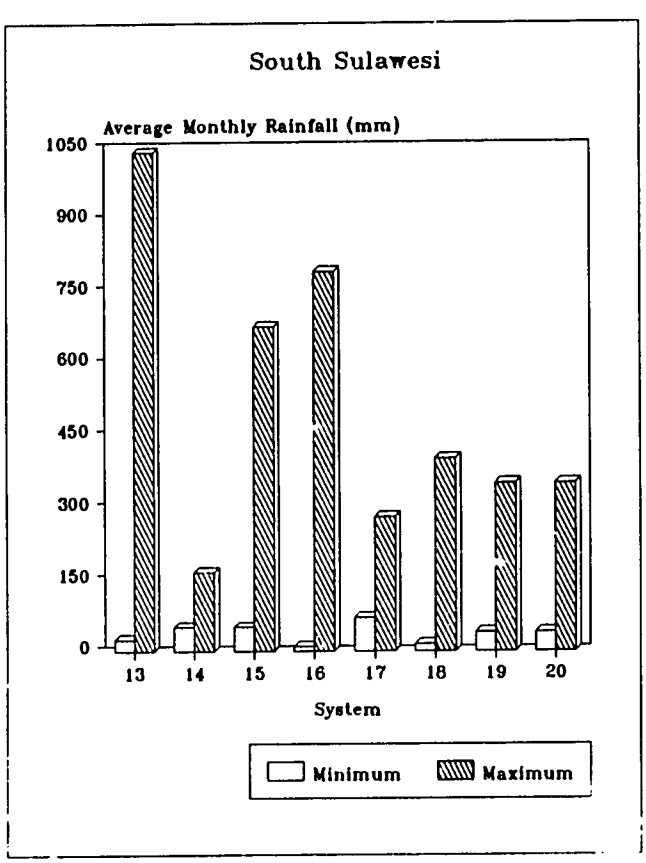
Measures	Value	Rate	Remark
Average Monthly Rainfall (AMR)	> 200 mm/mo.	10	Sufficient
	150-200 mm/mo.	7	
	100-150 mm/mo.	4	
	< 100 mm/mo.	1	Insufficient
Rainfall Distribution (RD)	< 75mm	10	Evenly distributed
	75-150 mm	8	
	150-225 mm	6	Unevenly distributed
	> 225 mm	4	

Figure 5

Minimum and Maximum Average Monthly Rainfall in Study Sites in JaBar, NTB and SulSel (1985-89)







West Java	West Nusa Tenggara	South Sulawesi
1. Cumanggala	5. Sidemen	13. Bulumarapa
2. Leuwi Jubleg	6. Bilikere	14. Panyili
3. Cikamal	7. Muncan	15. Kocikang
4. Cibojongkakak	8. Rempek	16. Leang-Leang
	9. Sindang Gila	17. Taretta
	10. Ireng Daya	18. Biangkeke II
	11. Mencongah	19. Biangloe V/VI
	12. Penimbung Kiri	20. Panaikang III

Table 10

Rating the Study Sites for
Water Sufficiency (AMR) and Availability (RD)

Site	AMR	RD	Rate
Sederhana			
West Java			
Leuwi Jubleg	177.3	70.3	17
Cibojongkakak	272.0	150.4	16
West Nusa Tenggara			
Sindang Gila	123.8	133.3	12
Rempek	105.2	103.3	12
Ireng Daya	153.9	74.9	17
Sidemen	154.0	137.2	15
South Sulawesi			
Bulumarapa	318.1	294.5	14
Panyili	111.1	33.8	14
Panaikang III	196.0	83.4	15
Biangloe V/VI	196.0	83.4	15
HPSIS			
West Java			
Cumanggala	239.1	195.5	16
Cikamal	201.5	91.4	18
West Nusa Tenggara			
Mencongah	153.9	171.4	17
Muncan	153.9	119.1	15
Bilikere	147.1	95.9	12
Penimbung Kiri	153.9	71.4	17
South Sulawesi			
Kocikang	224.8	210.5	16
Leang-Leang	293.7	253.3	14
Taretta	178.2	64.1	17
Biangkeke II	154.8	90.7	15

Design and Irrigated Area of the Study Sites

The design command is the net area of an irrigation system that can be converted into wetland. The potential area is that part of the design command having a completed main system infrastructure to serve it. The actual area is that part of the potential area that can be cultivated and irrigated by a system. Depending upon water availability, the actual area in the dry season may not be equal to the potential area. Only 8 of the 20 study sites have actual irrigated areas that approach the potential area (Table 11). In the remaining cases, the tertiary system or the *sawah* has not yet been developed.

Table 11

Irrigated Area of Sederhana and HPSIS Study Sites

Site	Design Area (ha)	Potential Area (ha)	Actual Irrigated Area (ha)		Average Yield of Rice (ton/ha of dry grain)	
			Wet Season	Dry Season	Wet Season	Dry Season
Sederhana						
West Java						
Leuwi Jubleg	532	532	324	320	3.4	2.9
Cibojongkakak	184	184	136	136	3.6	3.3
West Nusa Tenggara						
Sindang Gila	855	582	495	94	2.3	1.3
Rempek	654	654	179	177	3.2	2.8
Ireng Daya	253	253	253	253	3.4	2.9
Sidemen	688	613	470	470	2.9	2.4
South Sulawesi						
Bulumarapa	482	289	289	138	3.1	3.7[4]
Panyili	270	254	97	81	3.2	2.5
Panaikang III	233	233	187	187	3.4	2.5
Biangloe V/VI	699	699	697	697	4.2	3.9
HPSIS						
West Java						
Cumanggala	340	300	191	40[1]	4.0	3.4
Cikamal	226	226	226	226[1]	4.5	4.5
West Nusa Tenggara						
Mencongah	301	301	257	257	4.2	3.3
Muncun	324	324	26	26	3.4	3.6[4]
Bilikere	380	380	380	380	3.5	3.3
Penimbung Kiri	250	250	247	247	4.0	3.6
South Sulawesi						
Leang-Leang	643	572	572	40[2]	3.4	2.4
Kocikang	245	245	242	0[2]	3.4	N.A[5]
Taretta	337	337	192	7[3]	3.4	3.0
Biangkeke II	306	246	22	15	3.0	3.4[4]

1 The remaining land in the system is irrigated from another source in the dry season.
2 During the wet season, Leang-Leang and Kocikang systems are supplied by rainfed rivers that which are dry during the rest of the year.
3 The remainder of the command is used for rainfed tobacco.
4 Rice yields in the dry season are lower than those in the wet season because of water shortages, poor system O&M, and losses from pests.
5 Not applicable. No rice is grown in the dry season.

4

SEDERHANA PROJECT

Prior to Sederhana

Throughout Indonesia, small-scale irrigation systems were traditionally operated by farmers, but the organizational arrangements they employed varied considerably among and even within provinces. These differences are reflected in the ways farmers managed water distribution and system maintenance in the Sederhana study sites. In West Java and South Sulawesi, villagers either recruited and paid one of themselves to manage the water or were assigned a village government officer to do so. On Lombok, farmers formed a closely knit group (subak), which sometimes had associated ritual aspects, although they were not as elaborate as those in Bali.

Nine of the 10 study sites were farmer-managed irrigation systems prior to Sederhana; the exception was Sindang Gila, which was rainfed and lacked a delivery system until Sederhana. The systems were relatively small and could be irrigated only during the wet season. During the dry season, the command was left fallow or planted with rain-fed paddy or upland crops. Simple structures were already in place, usually dams made of bamboo, coconut tree trunks, and rocks, with a simple earth canal to deliver the water. These structures, often washed away in heavy rainfall or by rainy-season floods, had to be rebuilt yearly. Community members carried out the construction in *gotong royong*, a mutual assistance effort organized by the village head and supervised by the irrigation leader.

In West Java, water distribution and maintenance in the main system was supervised by ditch tenders (*ulu-ulus*). Farmers were responsible for operation and maintenance of the tertiary system. Systems tended to have more than one ulu-ulu, each overseeing roughly 30 to 50 hectares of the system. Ulu-ulus within a single system frequently had to work together, particularly in resolving conflicts between downstream farmers and users upstream who were diverting water disproportionately. Some ulu-ulus were members of the village government, which was ultimately responsible for the operation of the irrigation main system. More often, they were recruited out of the community by other farmers.

A village government ulu-ulu, like the other members of the village government, received of a piece of land (*bengkok*), in lieu of salary. A nonvillage government ulu-ulu served at the request of farmers and had the same responsibilities. As payment, he received from 5 to 25 kilograms of rice per hectare from farmers after the wet-season harvest. Although no sanctions existed for those farmers who did not contribute, study respondents recalled that most farmers made a yearly payment.

New construction and major repairs in the system were initiated by the village head, who recruited labor through his sub-village heads. The ulu-ulu supervised the activity. Simple maintenance efforts, including small repairs and weed and silt removal in the main system, were the direct responsibility of the ulu-ulu, who carried them out as necessary.

Before Sederhana, Leuwi Jubleg had four ulu-ulus: two appointed by the village government and two recruited by farmers. However, about two years before project implementation, they had ceased to work in those positions and operation and maintenance was conducted by the individual farmers instead. At project start-up, Cibojongkakak had two ulu-ulus recruited from and paid by the farmer community.

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In Lombok, farmers were members of long-term, traditional irrigation groups (subaks) led by a *pekasih*. Rempek, Sidemen, and Ireng Daya had one, three, and five subaks, respectively, each with its own leader. These groups appear to have operated independently of the village government. Various irrigation activities were focused on the pekasih, under whose leadership subak members regularly cleaned and repaired the system. As payment pekasihs received temporary rights to village land (*pecatu*). They also received a portion of the 25 kg of unhusked rice per hectare per season (*swineh*) that each farmer was to give to the leader of the quaternary irrigation system.

Operation and maintenance in three of the four South Sulawesi sites was carried out by the water overseer (*mandor jene* or *mandor uwae*). The difference in terms is a regional variation: *mandor* means supervisor. South Sulawesi lacked traditional irrigation associations like those in Lombok. As in West Java, the irrigation leader was a member of the village government or was recruited by the farmers themselves. Panyili had three mandors, two of whom were members of village government. The third was selected by the farmers but was approved by the village head. Biangloe V/VI and Panaikang III each had one mandor; neither was a member of village government. Like the ulu-ulu, the mandor jene/uwae was responsible for a portion of the total system—that part below a weir. In Panyili, farmers could not serve as mandor uwae in any part of the system where they held land. Presumably, the exclusion was intended to forestall conflicts stemming from self-interest or favoritism.

The mandor jene/uwae was responsible for water distribution, adjusting irrigation times to needs by regularly inspecting the fields, determining the need for structural repairs, and mobilizing farmers for repairs and maintenance. As in West Java, the mandor did not mobilize farmers directly; rather, he requested assistance through the village or sub-village head.

In Bulumarapa, the system was divided into six units, each defined by its own off-take structure. The units were supervised by a village elder (*pinati*), whose wide range of responsibilities included scheduling and organizing community ceremonies and events such as weddings, funerals, and planting. The pinati was the first member of the community to irrigate his fields.

Major repairs to the system were organized by the sub-village head, who also settled conflicts between farmers over water distribution. Each year before the rainy season, farmers were mobilized by the village government to repair the impermanent dam. Farmers carried out all other improvements on the irrigation structures.

Compensation for the mandor varied among the study sites. In Panyili, a farmer was expected to give the mandor the same weight of unhusked rice that he had used to plant his fields; elsewhere, farmers were expected to pay 25 kilograms per hectare of rice each season. In reality, only farmers who planted more than one-half hectare of rice actually paid. Mandors hired as village government members also received a direct payment from the *desa*.

Project Implementation

Institutions

As designed and implemented, Sederhana did virtually nothing to foster a participatory approach that would involve village leaders or water users in system development. Sites for Sederhana implementation were selected by PRIS officers, usually at the district level. In all 10 Sederhana systems examined, irrigation design and development took place without the involvement of the village government officers. Nor were traditional irrigation leaders consulted about the plans covering the location, size, and working network of canals and irrigation facilities during the design phase of

the project. The design was submitted to PU headquarters for approval, and, with few exceptions, only then was it shown to farmers.

Consultations with farmers might well have introduced different design views. For example, farmers in Cibojongkakak disagreed with the location of the intake structure designed by the officers, since the area to be irrigated was only 0.1 hectare. In both Panaikang III and Leuwi Jubleg, two drop structures were not functioning because they were placed above the canal. In Panyili, farmers used the old canals because water did not flow through the newly built ones. In Bulumarapa, the first system built was destroyed by a flood within three years of completion. Although the system was rebuilt, farmers were consulted neither time.

Exceptions to this general exclusionary practice were Rempek and Ireng Daya, where the local PRIS officers visited the village heads to inform them of the planned project and request that they assist the contractor who would handle the work. The village heads then informed villagers, usually in the mosque after the Friday prayer.

Difficulties arose when contractors built canals through farmers' land because the farmers requested compensation for the land used. In Panyili and Biangloe V/VI, the village head consulted the *kecamatan* and PRIS officers and mediated between contractors and farmers. As there was no budget to compensate for taken-over land, the only nominally acceptable solution was to have contractors give priority to hiring the affected landowners as laborers, paying them out of construction funds.

Contractors treated the ulu-ulu in West Java, pekasih in NTB, and mandor jene/uwae in South Sulawesi as any other farmers, and although the leaders were permitted to serve as construction laborers on projects, they could bring to bear none of their expertise in irrigation management. In all 10 Sederhana sites, the farmers considered the systems to be owned by the government and no longer their own common property.

As a result of the Sederhana interventions, PRIS had direct authority for main system operation and maintenance. PRIS officers managed the main canal after construction, except for West Java where the ulu-ulu was well established. The ulu-ulu continued to determine main canal water distribution in Leuwi Jubleg and Cibojongkakak.

In tertiary canals, however, farmers managed the water distribution. The exception was in Ireng Daya, where the *penjaga pintu air* was also involved. If the main canal was broken, the local PRIS agent made the repair. If part of the tertiary canal required repairs, farmers made them—initiated by the ulu-ulu in West Java, pekasih in NTB, and *kepala dusun* or kepala desa in South Sulawesi. However, if the damage was sizable, the farmers tended to wait for the government to initiate the repair, as they did in Rempek.

In the two West Java systems of Leuwi Jubleg and Bojongkakak, there was no significant operational change following project implementation. On Lombok, the subak's formal responsibility was limited to the tertiary canal, but farmers were mobilized by their pekasih before each wet season to clean the main canals.

In the South Sulawesi systems, the changes were more significant. In Biangloe V/VI, the mandor's position was absorbed into the *juru pengairan*'s office; mandors in Panaikang III and Panyili resigned and were not replaced. In the three systems of South Sulawesi individual farmers performed the operation and maintenance.

Physical Infrastructure and O&M

With the Sederhana Project the GOI made its first direct investment in the improvement, completion, and development of main and tertiary branches of small-scale irrigation systems. Through its physical infrastructure interventions (Table 12), Sederhana

was expected to improve water reliability during the wet and dry seasons, especially for wetland paddy areas.

After completing the construction at each site, responsibility for the main system transferred from the farmers to PU. Two PRIS staff, a dam watcher and gatekeeper, operated and maintained the main system. Gate watchers open and close the dam gate and regulate the water discharge from the dam; gatekeepers open and close the division or off-take gate and maintain the main canal. In Biangloe V/VI, the water master was appointed as gatekeeper, but in most cases the dam watcher and gatekeeper were farmers from the system.

Farmers remained responsible for the tertiary system. Their involvement in the main system, however, was limited to repairing damages when the PRIS officers were unable to do so because of budget constraints.

At all 10 Sederhana study sites, farmers participated in collective work at the behest of the village leader at least once a year, usually at the first wet season planting in West Java and NTB and in the wet or dry season in South Sulawesi. PRIS staff coordinated the work.

Agriculture

Agricultural extension bureaus in the provinces had ongoing programs introducing rice varieties and palawija crops and demonstrating new fertilizers. In some Sederhana sites, the Ministry of Agriculture took the lead in training agricultural extension officers and farmers in water management practices and system design.

Table 12

Infrastructure Improvements in Sederhana Sites

Site	Dam	Division off-take	Drop structure	Culvert	Spill-way	Chute	Flume
West Java							
Leuwi Jubleg	P,I	P,I,A	P,I,A	P,I	P,N		
Cibojongkakak	P,I	P,I,A	P,N	P,N	P,N		
West Nusa Tenggara							
Rempek	P,I	P,I,A	P,I,A	P,N		P,N	
Sidemen	P,I	P,I	P,N	P,N	P,N	SP,N	P,N
Sindang Gila	P,I	P,N	P,N	P,N	P,N		P,N
Ireng Daya	P,I	P,N	P,N	P,N			P,I
South Sulawesi							
Bulumarapa	P,I	P,N	P,N	P,N	P,N	P,N	P,N
Panyili	P,I	P,N		P,N		P,N	
Biangloe V/VI	P,I	P,I	P,N		P,N	P,N	
Panaikang III	P,I	P,I	P,N	P,I		P,N	P,I

SP Semi-permanent
P Permanent
N Newly built
A Additional structures
I Improved, upgraded, or rehabilitated

Results and Long-term Impact

Institutions

Because it focused largely on physical infrastructural improvements and lacked an agenda to enhance farmer participation, Sederhana is often characterized as a project with no specific institutional development objectives. Although clearly defined groups or clusters of farmers under recognized leaders existed in all of the systems, little effort was made to work with or through them. As a result, farmers did not participate in the design or implementation of system changes. No efforts were made to design or reach agreement on improved O&M schedules emerging from structural improvements. Nor were efforts made to build upon physical infrastructural improvements by concurrently introducing P3As or other organizational innovations.

However, Sederhana did introduce highly significant institutional changes that are still in place today and have repercussions for GOI efforts to form P3As and institute turnover or user fee programs. Sederhana was the means by which PU made its first interventions and thus secured a foothold in small-scale irrigation throughout the country. As a result, relations and responsibilities of actors in the systems were highly modified. As the systems were completed, PU detailed irrigation staff—a local officer (juru pengairan in West Java and NTB and *kepala subranting* in South Sulawesi) and a gatekeeper (penjaga pintu air). Thus, through Sederhana, PU first established a permanent presence and claimed responsibility for main system O&M, previously in the hands of the village government or farmer-appointed leaders. In some cases, these responsibilities shifted to the village government rather than to PU.

This shift in responsibilities was a more significant change in system operation than the government's widespread and unsuccessful efforts to establish homogeneously structured P3As throughout the country. The shift to PRIS of main system responsibility not only weakened the irrigation role of the village government and farmers but also unwittingly undermined P3A organizing efforts, since in these new entities farmers had less power than in traditional arrangements. As a result, P3As offered few attractions to farmers.

Assessments of irrigation development throughout Asia have revealed that when systems are constructed without farmer involvement, the users are less likely to participate in system operation and maintenance. They are also less likely to participate in government-sponsored or -introduced users groups or to follow government O&M guidelines, whatever their desirability. The Sederhana experience confirms this perspective. Few organizational benefits were actually derived from the Sederhana construction program. Without a convincing case being made for why they should reorganize themselves into new associations with new leaders and responsibilities, farmers clearly preferred to retain their traditional, largely successful arrangements. The presence of these other arrangements probably contributed as much to the P3As' lack of success as did the timing of their introduction. The HPSIS experience indicates that even when P3As were introduced as part of a construction program, they were short-lived. A third concomitant factor was the absence of real or clear responsibilities for the groups.

During the period of Sederhana implementation and in the ensuing years, P3As were established in nine of the ten Sederhana study sites. The exception is Biangloe V/VI, where the village head decided unilaterally that a P3A was unnecessary since the system had abundant water and had little to gain by P3A introduction.

No clear relationship exists between Sederhana interventions and the P3A creation in the nine systems. Table 13 indicates that P3A formation was not coordinated with Sederhana implementation and that the number of P3As formed often had little correspondence to the number of traditional groups, an indication of how farmers perceived of organizational constraints.

Table 13

P3As and Sederhana Implementation

Site	No. of Traditional Groups	No. of P3As Formed	Year P3A Formed	Years of Sederhana Implementation
West Java				
Leuwi Jubleg	4	3	1987	1979-79, 1982-83
Cibojongkakak	2	1	1989	1976-77
West Nusa Tenggara				
Sindang Gila	–	2	1983,1985	1980-81
Rempek	1	1	1987	1979-80
Ireng Daya	3	1	1978	1978-79
Sidemen	6	1	1978	1976-77, 1977-78
South Sulawesi				
Bulumarapa	6	1	1980	1975-76
Panyili	3	4	1987	1976-77
Panaikang III	1	1	1978	1981-82
Biangloe V/VI	1	–	–	1978-79

By 1990, the only P3A still functioning in the study sites was in Sindang Gila, where farmers had not practiced irrigated agriculture prior to Sederhana (Table 14). In 1981, immediately after completion of the new system, farmers formed a subak. However, in compliance with subdistrict regulations, the village government organized a P3A for Sindang Gila in 1983, and the subak was disbanded. In 1985, with the expansion of its rice fields, the P3A split into two groups, which continue to function

Table 14

Irrigation Leaders Before and After P3A Formation in Sederhana Sites

Site	Before	No. P3A Formed	Current Leaders
West Java			
Leuwi Jubleg	4 ulu-ulus	3	4 ulu-ulus
Cibojongkakak	2 ulu-ulus	1	1 subvillage head, 3 ulu-ulus
West Nusa Tenggara			
Rempek	1 pekasih	1	1 pekasihs
Sidemen	6 pekasihs	1	6 pekasihs
Sindang Gila	–	2	2 P3A chairman, 11 pekasihs
Ireng Daya	3 pekasihs	1	3 pekasihs
South Sulawesi			
Panyili	3 mandor uwae	1	4 ketuas kelompok tani[1]
Bulumarapa	6 pinati	1	3 village heads, 6 pinati
Biangloe V/VI	1 mandor uwae	–	6 ketuas kelompok tani
Panaikang III	1 mandor uwae	1	4 subvillage heads

[1] Leader of an agricultural farmer group.

actively—arranging water distribution schedules and rotations of the command for irrigated rice and palawija during the dry season, scheduling gotong royang for cleaning and repairing canals, and collecting fees from members for skilled labor and materials after paddy harvest. Sindang Gila's two P3As are divided into five and six farmer groups that users call subaks but appear to operate more like *kelompok tani*, since they operate as P3A subdivisions rather than as independently operating subaks. Farmers have borrowed the local term as a way of situating the group structurally.

Elsewhere, P3As never survived the original meeting. The study team could find no instances where system O&M was done at any time under P3As, from their creation to the present. There were no follow-up meetings of their memberships, and farmers did not contribute to their support or to the salary of the P3A leaders. Instead, farmers continued to pay the ulu-ulu or the pekasih as long as that position existed. In Sidemen, the pekasih was also elected leader of the P3A but actually continued to operate through the subak; it was because of his position in the subak that he was paid by farmers.

Probably Sederhana's most significant long-term impact has been the presence of PRIS representatives in the systems. Table 15 clearly indicates the impact of this change in main system management. In some cases, traditional farmer groups and leaders are relegated to tertiary system management; in others, parties responsible for irrigation O&M prior to Sederhana have disappeared. Formally, West Java's ulu-ulus and Lombok's subaks have few, if any, main system responsibilities, but they have fared better than South Sulawesi's mandor jene/uwae and pinati. These positions were either dissolved, as in the former, or are now alienated from irrigation, as in the latter.

In practice, relations between PRIS staff and farmers can be supportive and productive. In five of the ten systems (Leuwi Jubleg, Cibojongkakak, Ireng Daya, Sidemen, and Panaikang III) PRIS staff continue to depend upon farmers for main system O&M, including canal cleaning and gate operation. The juru pengairan in each of these systems has offered the gate keys to the pekasih, village officials, or trusted farmers so they can open and close the gates. The division of labor between PU and the farmers is outside the usual regulations, but staff shortages in local PU offices make the further involvement of water users in system operation a reasonable strategy. The situation has gone so far in Leuwi Jubleg that the ulu-ulu continues to have the primary responsibility for water distribution, although for no other areas of main system management.

In Lombok, the three subaks predating the project continue to function, but the subak members now operate more as clusters of farmers in the quaternary system than as a unified group under a leader responsible for O&M of the entire system. Responsibilities have dropped to the tertiary system. PRIS has assumed responsibility for main system O&M, including regulating water distribution and undertaking structural repairs. Work by entire subak membership under the pekasih is less frequent and less necessary. In Rempek, the pekasih now operates primarily as the leader of one of the quaternary groups.

Table 15 indicates that the responsibilities of the GOI and farmers are most distinct in South Sulawesi; with little variation among the four sites, PRIS clearly has responsibility for the main system and the farmers for the tertiary. With the completion of the physical improvements, the water masters and the village elder ceased their responsibilities. The pinati continues to decide planting times and to assist in deciding the cropping pattern, but he is no longer directly involved in irrigation. Individual farmers now manage the tertiary system but have no direct managerial role in the main system.

Physical Infrastructure and O&M

The most immediate and dramatic impact of Sederhana's improvements in the physical system

Table 15

Current Responsibilities for Irrigation Management in Sederhana Study Sites

Systems Activities	West Java		West Nusa Tenggara				South Sulawesi			
	Leuwi Jubleg	Cibojongkakak	Ireng Daya	Sidemen	Rempek	Sindang Gila	Panaikang III	Biangloe V/VI	Bulumarapa	Panyili
Fee collection										
a. Salary	2	2	3	3	3	1/3	–	–	–	–
b. IPEP	–	–	–	–	–	–	10	10	10	10
Distribute main system water	2/11	2	2/10	2/10	10	1/10/11	2/11	11	11	11
Distribute tertiary system water	2/6	6	3	3	3	3	6	6	6	6
Repair main system	2/9	9	2/9	2/9	9	1/9	2/9	9	9	9
Repair tertiary system	2/6	2/6	3/6	3/6	3/6	1/3/6	6	6	6	6/7/8
Clean main system	2/12	12	2/12	2/12	12	1/12	2/12	12	12	12
Clean tertiary system	2/6	6	6	3/6	6	3/6	6	6	6	6
Decide cropping	10/13	10/13	10/13	10/13	10/13	1/10/13	10/13	10/13	4/10/13	8/10/13
Decide planting time	–	8/10/13	–	–	–	1/7/10	–	5	4	7
Decide crop rotation	–	–	–	–	–	1/7/10	–	–	–	7
Resolve conflict	2/7	8	3	3	3/7/10	1/3/7/8	10	5	10	7/8

Farmers and farmer groups
1. Water user association (P3A)
2. Ditch tender (Ulu-ulu)
3. Subak and Pekasih
4. Village elder (Pinati)
5. Farmers group (Kelompok tani)
6. Individual farmer (Petani)

Village government
7. Village head (Kepala desa)
8. Subvillage head (Kepala dusun)

Government of Indonesia
9. Provincial Irrigation Service/PRIS (PU Pengairan)
10. PRIS officer (Juru pengairan/Kepala subranting)
11. Gatekeeper (Penjaga pintu air)
12. PU laborers (Pekerja harian tetap)
13. Agricultural Extension Agent (PPL)

was the introduction of a second irrigated crop. Farmers no longer were restricted to growing palawija. At most sites, the actual irrigated area in the wet season increased from single to double paddy, and in some cases there was also a single palawija crop.

In Sindang Gila, a new irrigated system was developed where prior to the project a dam and canal delivered water only for domestic use. Sederhana developed the dam and canal into permanent structures and expanded their use to include irrigation. This area had been in secondary forest, shrubs, and grasses; the cleared section was used in a resettlement project for local transmigrants from West Nusa Tenggara.

As shown in Table 16, in six of the NTB and SulSel sites, the irrigated area increased under Sederhana, and new rice fields were developed as the irrigation system was expanded. The command areas of Leuwi Jubleg and Cibojongkakak were virtually the same after the project, but increased irrigation water, especially in the dry season, encouraged farmers to grow wet paddy. Following construction, the entire commands were irrigated in both wet and dry seasons.

During the study, the present condition of the structures in the 10 systems was examined and assessed (Table 17). The walls, floor, and foundation of dams, canals, and other structures were observed for major destruction, leakages, cracks, and holes. Three levels of relative physical conditions were determined: good to fair (>75 percent), bad (50-75 percent), and severe (<50 percent). Because the structures were built several years ago, the best condition now possible would be 90 percent. Rating was based on all of the structures of a particular type, rather than on individual structures.

The worst conditions exist in the West Java sites, which average 70 percent, and the best in NTB, which average 81 percent. Those in South Sulawesi average 75 percent. These conditions relate to site selection, the materials and construction quality, and PU's level of maintenance in the main system and

Table 16

Comparison of Actual Irrigated Area Prior to Sederhana and at Present in Study Sites

Site	Prior to Sederhana	At Present	
		Wet Season (ha)	Dry Season
West Java			
Leuwi Jubleg	320	320	320
Cibojongkakak	136	136	136
West Nusa Tenggara			
Sindang Gila	0	495	94
Rempek	78	179	177
Ireng Daya	234	253	253
Sidemen	302	470	470
South Sulawesi			
Bulumarapa	167	289	138
Panyili	97	97	81
Panaikang III	86	187	187
Biangloe V/VI	699	697	697

Table 17

Assessment of the Present Condition of Structures in the Sederhana Study Sites

Site	Condition (%)
West Java	
Leuwi Jubleg	65
Cibojongkakak	75
West Nusa Tenggara	
Rempek	75
Sidemen	84
Sindang Gila	88
Ireng Daya	75
South Sulawesi	
Panyili	67
Bulumarapa	70
Biangloe V/VI	79
Panaikang III	82

farmers' in the tertiary. Some damage comes from animals and floods; in the canals, farmers cause damage if they break the lining to create direct outlets to their own fields.

At seven of the ten sites, juru pengairans supervised one to seven other systems, so the time the juru pengairan could devote to any one system was severely limited. Only in Rempek, Bulumarapa, and Sindang Gila sites was the juru pengairan's responsibility limited to the management of that system.

Structural conditions cannot be attributed solely to the level of the juru pengairan's involvement. A more important reason relates to water sufficiency and availability. In systems where water is sufficient and available for both wet and dry season cultivation, farmers are decidedly less willing to maintain structures that do not appreciably affect the water supply. In the West Java sites, the structures are poorly maintained largely because they need not be in good condition for farmers to receive an adequate supply of water.

A regression analysis was made to correlate water sufficiency and availability with the physical structure in each of the sites (see Table 18). The calculated correlation coefficient of $r = -0.73$ indicated that the greater the water sufficiency and availability, the poorer the system's physical condition. Conditions were worst in those systems with the greatest water sufficiency and availability, since water was reliable regardless of structural conditions.

Following implementation, the GOI and farmers continued to invest in the systems, primarily to complete, develop, repair, or rehabilitate structures (Table 19). The investments were intended to prolong the life span of the system, while the maintenance was intended to extend the time period between rehabilitations or repairs. In 1981-82, the GOI developed the tertiary system in Sidemen at a cost of Rp. 14 million, and in 1985-89, it rehabilitated the dam, the primary and secondary canals, and lined the water reservoir in Panyili for Rp. 41 million. These relatively high GOI contributions were made because only relatively simple structures instead of permanent ones had been built during the project. Farmers generally contributed labor and materials, such as rocks, which they had on hand or gathered.

Agriculture

Since project implementation ended, the farmers' cropping pattern has not changed significantly (Table 20). However, the cropping intensity has increased because of better use of inputs, improved cultural practices, and increased availability of irrigation water for growing rice and palawija crops during the dry season. (See Appendix G for detailed cropping patterns of each site.)

Rice has remained the main crop in the wet season. In eight sites, farmers plant rice twice a year. The increased availability of water and the cultivation of high yielding varieties with shorter growing seasons than local varieties enables these farmers to do their rice-plantings twice a year.

In Rempek and Panyili, farmers plant rice once a year and palawija twice because there is too little

Table 18

Relationship Between Water Sufficiency and Physical Condition of the Sederhana Systems

Irrigation System	Rate (X)	Physical Condition (Y)	Result/Correlation Between X and Y
West Java			The regression line:
Leuwi Jubleg	17	65	Y=103 - 2.535 X
Cibojongkakak	16	75	The correlation co-efficient: r = -0.73
West Nusa Tenggara			
Sidemen	15	84	
Rempek	12	75	
Sindang Gila	12	88	
Ireng Daya	17	75	
South Sulawesi			
Bulumarapa	14	70	
Panyili	14	67	
Biangloe V/VI	15	79	
Panaikang III	15	82	

water to plant rice in the dry season. In the West Java sites, the cropping pattern has not changed, but some farmers can now plant rice three times a year; some of them also stock the sawah with fish, the sale of which helps to defray the costs of rice cultivation.

At Sindang Gila, irrigated rice was planted in the dry season in a P3A-organized rotation system: those farmers who grew rice one dry season would grow palawija crops the next.

Agricultural inputs such as fertilizers and insecticides are normally used for rice and palawija. Extension efforts to improve cultural practices were carried out by the agricultural extension agents, whose work intensified after Sederhana. In West Java and South Sulawesi, farmers who had applied 100 kg urea/ha before Sederhana and 50 kg TSP/ha doubled the application after the project. Before Sederhana, farmers in NTB had rarely applied fertilizers; afterward, they used 300 kg/ha of urea and 100 kg TSP/ha. The resulting change in yields is shown in Table 21.

One would expect dry-season rice yields to be higher than those in the wet season because of higher solar energy. In the study sites, however, dry-season rice yields are generally lower than those of the wet season because of water shortages, poor system O&M, and pest damage.

Table 19

Investment after the Sederhana Project in the Study Sites

Site		Government		Farmers	
		Contribution (Rp. 000,000)	Year	Contribution (Rp. 000,000)	Year
West Java					
Leuwi Jubleg	Main canal repair			labor, material	1980, 1985
Cibojongkakak	Rehabilitation of intakes	9.5	1978, 1988		
	Repair of dikes		1990	labor, material	1989, 1990
West Nusa Tenggara					
Rempek	New construction of intakes			labor, material, .20	1981
	Repair, and canal lining	labor	1987		1990
Sidemen	Tertiary system development and canal lining	13.9	1982	labor, material, .18	1979, 1983
Sindang Gila	New construction of intakes and boxes, dam repair			labor, material, .35	1984-90
Ireng Daya	Canal lining and repair	3.9	1985-86, 1988	labor, material, .59	
South Sulawesi					
Bulumarapa	Primary & secondary canal repairs	6.8	1990	labor	
Panyili	Upgrading & rehabilitation dam, canal, and reservoir lining	41.3	1986-89	labor, material	1980, 1989
Panaikang III	Dam & canal repair	9.2	1987, 1989		1987, 1989
Biangloe V/VI	Canal lining & repair	1.2	1982	.28 labor	1988-1990

40.

Table 20

Cropping Pattern in the Study Sites Prior to Sederhana and at Present

Site	Prior to Sederhana	At Present
West Java		
Leuwi Jubleg	Rice-Rice-Fallow	Rice-Rice+Fish-Fallow
Cibojongkakak	Rice-Rice-Fallow	Rice-Rice+Fish-Fallow
West Nusa Tenggara		
Sindang Gila	–	Rice-Rice/Palawija-Fallow
Rempek	Rice-Palawija-Fallow	Rice-Palawija-Palawija
Ireng Daya	Rice-Palawija-Fallow	Rice-Rice-Palawija
Sidemen	Rice-Palawija-Fallow	Rice-Rice-Palawija
South Sulawesi		
Bulumarapa	Rice-Fallow	Rice-Rice-Fallow
Panyili	Rice-Palawija-Fallow	Rice-Palawija-Palawija
Panaikang III	Rice-Rice-Fallow	Rice-Rice-Palawija
Biangloe V/VI	Rice-Fallow	Rice-Rice-Palawija

Table 21

Rice Yield in Study Sites (Dry Grain)
(ton)

Site	Before Sederhana	After Sederhana	
		Wet Season	Dry Season
West Java			
Leuwi Jubleg	2.0	3.4	2.9
Cibojongkakak	2.6	3.6	3.3
West Nusa Tenggara			
Sindang Gila	0.0	2.3	1.3
Rempek	2.4	3.2	2.8
Ireng Daya	1.6	3.4	2.9
Sidemen	1.4	2.9	2.4
South Sulawesi			
Bulumarapa	1.6	3.2	3.7
Panyili	1.7	3.2	2.5
Panaikang III	1.8	3.2	2.5
Biangloe V/VI	2.8	4.2	3.9

5

HIGH PERFORMANCE SEDERHANA IRRIGATION SYSTEMS PROJECT

Prior to HPSIS

The 10 HPSIS systems under examination differed in a number of characteristics. Most of the systems had already been developed or improved under the Sederhana projects. Most were quite old, with complex management arrangements already established. At others, only rain-fed agriculture had been conducted prior to HPSIS; irrigation was a new endeavor. Finally, in some of the systems, government-introduced P3As had already been formed prior to HPSIS. Project designers attempted to account for some of these differences by identifying three types of project sites, based on the condition of the physical infrastructure: system development, system development and management, and system management. Each type would receive a distinct set of interventions.

Eight of the 10 HPSIS systems examined were also Sederhana sites and, therefore, had partially or fully developed physical infrastructures when HPSIS began. The remaining two, Muncan and Taretta, were still farmer-managed systems and yet to receive any government interventions. Muncan, a system in Lombok, had four active subaks managing irrigation activities. Membership in a subak corresponded to the hydrological characteristics of the system. The Muncan system was served by four rivers, which supplied water only during the wet season. Each subak used a different source of water for irrigation. In the other three Lombok systems, the subaks were residential units, and subak membership was analogous to residence in a particular subvillage.

Taretta, a South Sulawesi system, had a mandor uwae recruited and supported by the farmers, but the system had a history of severe disruption. From 1957 to 1962, rebels took over the area, and irrigation was not practiced because the land was not worked. Taretta's 200 villagers fled to the safety of nearby mountains. When order was restored, the farmers returned to find their tertiary system in ruins. The community rebuilt the pond and the intake system—children bringing stones from a site two kilometers away and women carrying sand. Within a month the system was functioning again.

In 2 of the 10 systems, irrigation was of relatively brief duration. One system, Leang-Leang, had virtually no irrigation prior to HPSIS; only 10 hectares were irrigated with the rest in rain-fed rice. In Biangkeke II, irrigation was not introduced until 1969, when a simple dam was built across a river under the supervision of a military man who had newly moved into the area. Farmers then managed the O&M under his direction.

By the time HPSIS was introduced, farmers in four of the systems—Mencongah and Muncan in NTB and Leang-Leang and Biangkeke II in SulSel—had already been organized into P3As, in some cases for as long as three years. Pre-HPSIS organizing was similar among the sites: P3As were formed at the order of the district (kabupaten) or subdistrict (kecamatan) head. Usually, the local agricultural extension agent called a meeting that was attended by the village and subvillage heads and other important community members. In each of the four systems, the P3A became inactive as soon as it was

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organized; however, its formal creation did fulfill the letter of the local government requirements, if perhaps not the spirit.

Implementation

Institutions

Community Organizers

The introduction of community organizers (COs) as organizational catalysts in the P3A efforts was probably HPSIS's most distinctive and original intervention. In fact, PU had sponsored physical infrastructure improvements to small-scale systems since 1974, and P3As had been formed for at least five years albeit with disappointing results. The COs were to change the face of the program, signifying PU's continuing commitment to institutional change at the systems level. Recruited as a cadre of personnel specifically mandated to live and work with farmers full-time at the sites, the COs were to encourage farmers to operate through the P3As. PU had already established a presence in the systems through locally based staff, but the community organizers were of a different order. Although recruited by PU, they were not part of its staff. They were clearly not technicians, and their flexibly defined positions allowed them to emerge as farmer partisans and thus secure greater farmer confidence and cooperation. COs were the backbone of PU's participatory approach.

In all, 22 COs were posted to the 10 study sites, following training by LP3Es. The organizers were relatively well educated: 18 were high school graduates (*Sekolah Menengah Atas*), 1 had three years of college (*sarjana muda*), and 3 had four or five years of college (*sarjana*). The COs resided in homes of village government officers or prominent farmers, with the exception of those in Kocikang, who lived in the village during the wet season and in Ujungpandang the rest of the year, and those in Taretta, who lived in a neighboring village. COs were assigned to specific systems, often for several years (Table 22). In the process, they became knowledgeable about farmer constraints and could relay information back to PU to resolve misunderstandings.

Given the division of the sites into three explicit types, each requiring different institutional inputs, CO activities were surprisingly uniform among the

Table 22

CO Postings in HPSIS Sites and P3A Formation

Implementation Type	Date CO Started	Date P3A Formed	Date CO Departed
System Development			
Muncan	January 1984	August 1985	August 1985
Taretta	February 1983	June 1985	October 1985
System Development and Management			
Cikemal	December 1983	September 1984	September 1985
Bilikere	January 1984	April 1985	August 1985
Penimbung Kiri	August 1982	September 1983	December 1985
Kocikang	August 1982	April 1983	December 1985
Biangkeke II	January 1984	August 1984	October 1985
System Management			
Cumanggala	October 1982	January 1984	August 1985
Mencongah	August 1982	September 1983	December 1985
Leang-Leang	August 1982	November 1982	December 1985

systems. Nearly all COs lived in or near villages, although sometimes they resided with village leaders or in PU housing. All were commended for having tried to integrate themselves into the community by attending prayers at the mosque and other ceremonies, such as funerals. All held initial and follow-up meetings with village leaders and water users to explain their presence in the villages. Where construction would be undertaken, they explained that the system would be developed or expanded. Many were described as knowledgeable about irrigation and helpful in resolving problems. However, in Muncan (a new system), farmers recalled that COs had not mastered the technical aspects of irrigation or agriculture and often could not answer questions or did so incorrectly. COs in other areas were also described as less helpful in dealing with agricultural problems.

In all the systems, P3A formation was closely tied to brief farmer-training programs in water management and administration. Training appears to have been uniform in content and length, although the timing of the training introduction depended upon when infrastructural improvements were completed and the P3A formed. In most cases, farmer training was not provided until shortly before the departure of the COs, who often had already been in place for several years.

As noted, HPSIS sites were implemented as three types: system development, system development and management, and system management. Each type represented a particular level of infrastructure development at project inception, and each determined a particular level of project inputs. This section examines how HPSIS institutional interventions matched the construction initiatives. In general, the more physically developed the system, the greater the emphasis on introducing institutional changes and new management practices.

System Development (SD)

This type of site required both main and tertiary system development. COs worked with farmers to plan the system, consign land for system construction purposes, supply labor during construction, and form P3As. The command was divided into units or "blocks"—each with its own members and leader—that were responsible for a subdivision. Muncan and Taretta, where Sederhana had not been implemented, were system development sites.

PU staff prepared system designs, which they reviewed with farmers while walking through the command. In both systems, PU staff walked through with several prominent farmers and a village government officer and noted comments on the design. The COs in Muncan participated in the walk-through of the entire system, but those in Taretta were involved only in the tertiary system walk-through. However, the broader body of farmers was not included, despite there having been a number of such walk-throughs made. Three walk-throughs were made in Muncan and four in Taretta.

During project implementation, land acquisition became an important activity—especially in Muncan where new canals included a 5-km main canal, 4.5 km of tertiary canals, and 17 km of quaternary system. Farmers demanded compensation for the land they lost, but funds were not available. Although the CO gave much of his time to resolve the issue, despite his efforts funds were never appropriated.

COs initiated ad hoc groups for canal-building by organizing farmers to work as laborers. In Muncan, groups were formed and the groups and contractor agreed upon a compensation of Rp. 650 per cubic meter of canal built, with Rp. 50 of that amount set aside for the P3A. In Taretta, a disagreement arose between the contractor and farmers from one of the two villages in the system; the farmers eventually refused to work, and those from the other village undertook the work instead. Like the community organizer in Muncan, the Taretta CO spent much of his time trying to resolve problems over land acquisition, which were really outside his control. The COs appear to have had trouble determining priorities and sorting out the most effective use of their time and energy.

P3As were formed in the two SD sites only after the systems were developed, which was shortly before the COs ceased their work. The COs had tried to prepare the farmers, but the actual organizing efforts were unreasonably concentrated into a brief period, so preparations were almost meaningless. P3As in Muncan and Taretta were formally organized in one meeting attended by the village head, eminent village residents, and farmers. The village head presented his views, there was limited participation from others attending, and the organization was established.

In Muncan, the COs arrived in January 1984 and did not form the P3As until August 1985, the month they left. In Taretta, COs arrived in February 1983 and formed the P3A in June 1985. Because they left the system a few months later in October 1985, the COs had no time to assist the P3As in their actual operations during the initial year when they were most fragile.

System Development and Management (SDM)

SDM sites required only tertiary construction, since their main systems were already developed. In these five systems, the P3As were formed early. Other activities, including system planning, land acquisition, and the provision of construction labor by farmers, were to be carried out through the P3A.

COs primarily operated through the more influential members of the village, rather than by interacting with the broader farmer community. There were minor variations, but generally the P3A was organized with limited farmer participation and emphasized open or restricted formal meetings.

In Cikamal, the CO's first effort was to form 16 groups comparable to system subsections. Each group was to be headed by a leader. Following the formation of the P3As, leaders (chairman, secretary, and treasurer) were chosen in consultation with village government officers and the more important village residents. Only then was there a general, but largely ceremonial, meeting of the P3A membership to rubberstamp the selection.

In Bilikere and Penimbung Kiri, P3A activities were similar to those in Cikamal. The COs dealt only with the local government and prominent citizens, but in Bilikere and Penimbung Kiri there was no meeting of the full membership to confirm its formation.

The COs in Biangkeke II and Kocikang called a meeting attended by members of the village government and all of the farmers. System designs were discussed in P3A meetings and walk-throughs with PU officers, group leaders, and members of the local government. Land acquisition was settled through the P3As. The COs arranged meetings where they explained that there would be no compensation for their land.

During construction the farmers participated as laborers through their P3A, to which they turned over a portion of their earnings. In Cikamal, farmers contributed Rp. 150 of the Rp. 1,750 they earned per day; in all, Rp. 800,000 were collected in Bilikere and Rp. 608,000 in Penimbung Kiri for the P3As.

Unlike the SD sites, P3As were formed roughly a year after the COs arrived in the five SDM sites and from one to two years before they left the systems.

System Management (SM)

Cumanggala, Mencongah, and Leang-Leang were SM sites. They had fully developed main and tertiary systems constructed under the Sederhana Project or afterward. With little or no physical infrastructure development required, HPSIS focused on institutional development, particularly on the formation and strengthening of the P3As (see Table 23).

Cumanggala's main and tertiary systems were completed in 1980. At that point, PRIS staff gave one of the three ulu-ulus gate keys to manage

Table 23

COs Residence, P3A Formation, and Farmer Leaders in the HPSIS Study Sites

Site	Number of COs	Years in System	No. Traditional Leaders or Groups Before P3A	Number P3As	Date P3A Formed	Date of HPSIS Implementation
West Java						
Cumanggala	2	3,3	3	3	1984	1982-85
Cikamal	3	2,2,2	1	1	1984	1982-84
West Nusa Tenggara						
Mencongah	2	3	4	1	1981-83	1984-85
Muncan	3	<1,2,2	4	2	1983	1984-85
Bilikere	2	2,2	5	3	1985-88	1984-85
Penimbung Kiri	3	3,3,3	3	1	1983	1982-85
South Sulawesi						
Leang-Leang	2	1,3	–	2	1980-82	1982-85
Kocikang	2	1,3	5	1	1983	1982-85
Taretta	3	<1,1,2	1	1	1985	1983-84
Biangkeke II	2	2	–	1	1981-85	1984-85

O&M in the main canals, because PRIS could not post a juru pengairan in the system. At the initiative of the two COs, P3As were organized in each of the three villages serviced by the Cumanggala system. One of the three ulu-ulus was appointed P3A secretary; the other two were made responsible for main system O&M. Members in each of the P3As agreed to contribute 35 kg of unhulled rice to the P3A and also agreed upon how it would be allocated. With small variations among the P3As, the funds from the sale of the rice were to pay for administration, routine repairs, rehabilitation, and leader salaries. During 1982-84, while the COs were still based in the systems, roughly half the farmers in each P3A contributed.

In Mencongah, a single P3A had been formed by the agricultural extension agent in 1981, but it lay dormant until 1983 when the COs entered the system. Meetings were organized with influential villagers, but more importantly, the COs met with each pekasih and subak members individually to discuss the program. Finally, the COs convened a meeting of all system water users, at which time the farmers selected P3A leaders, including a former pekasih as chairman, and determined that each farmer would contribute 25 kg of unhulled rice per hectare for services and salaries. Following its first three wet seasons, the P3A collected rice that it was able to sell for Rp. 375,000. These funds were used to repair a broken tertiary system box and to purchase land for the P3A office.

Leang-Leang's P3A also predated HPSIS. Formed in 1980, the P3A was inactive until late 1982 when the COs revived it. Following a series of meetings, leaders were selected, including the chairman, who was head of the village elementary school. According to the P3A rules, farmers were to contribute 30 kg of unhusked rice per hectare to be used as follows: 40 percent for O&M, 40 percent for management, 15 percent for savings, and 5 percent for salaries. However, in practice, farmers never contributed, likely because the system functions only in the wet season. These P3As were re-formed about a year after the COs arrived and two to three years before they left.

Physical Infrastructure and O&M

A variety of structures were rehabilitated or newly built during HPSIS (Table 24). Some improvements in a few systems were initiated by farmers. After farmers had an opportunity to review designs the contractors prepared for PU, they suggested changes in the location of structures, the direction of tertiary or quaternary canals, and the addition of structures. In Muncan, the PRIS and contractor accepted 12 of 17 farmer proposals; in Bilikere, PU and the contractor accepted 8 out of the 12, and in Penimbung Kiri, 18 of 19.

Operation and maintenance during HPSIS implementation differed little from the arrangements used previously. During implementation, no ostensible effort was made to establish O&M schedules that could be carried out by the P3As being established. During HPSIS implementation, main system operation was the responsibility of local PRIS staff, but they played more- or less-active roles in the different provinces.

In general, the tertiary system was divided into blocks for O&M, with smaller numbers of water users organized into working groups. O&M in West Java was supervised by main and block ulu-ulus. On Lombok, pekasihs continued to determine water distribution in the tertiary systems, but maintenance was handled by block leaders. In South Sulawesi, the main system operation was handled by system-level PRIS staff, while in the tertiary system, farmers formed block working groups.

Agriculture

Unlike Sederhana, which provided no agricultural interventions or improved practices, HPSIS offered farmers direct assistance in farm management, including guidelines for a cropping pattern, the introduction of a high-yielding rice variety resistant to the leaf hopper, improved cultural practices, and guidance to P3A members on controlling crop pests and diseases. COs carried out these activities in cooperation with the extension agent. The COs also joined with the juru pengairan and the extension

Table 24

Infrastructure Improvements in HPSIS Study Sites

Site	Dam	Division off-take	Drop structure	Culvert	Side spillway	Chute/ Flume	Main canal	Tertiary canal
West Java								
Cumanggala								
Cikamal				N	N	N	N	
West Nusa Tenggara								
Mencongah								
Muncan	R	N			N	N	N	N
Bilikere	R	N	N			R	N	
Penimbung Kiri								N
South Sulawesi								
Leang-Leang								R
Kocikang								N
Taretta	N	N	N		N		N	R
Biangkeke II					N		N	N

R Rehabilitated structure already in place and upgraded from simple design and materials to semipermanent or permanent, according to GOI-approved specifications.
N Newly built

Table 25

Irrigation Leaders Before and After P3A Formation under HPSIS

Site	Before	No. P3A Formed	Current Leaders
West Java			
Cumunggala	3 ulu-ulus	3	3 ulu-ulus
Cikamal	6 subvillage heads[1]	1	6 subvillage heads
West Nusa Tenggara			
Mancongah	4 pekasihs	1	4 pekasihs
Muncun	4 pekasihs	1	6 pekasihs
Bilikere	5 pekasihs	3	5 pekasihs
Penimbung Kiri	3 pekasihs	1	3 pekasihs
South Sulawesi			
Leang-Leang	2 subvillage head	2	4 ketuas kelompok tani[2]
Kocikang	1 pinati	1	village secretary
Taretta	1 mandor uwae	1	4 subvillage heads
Biangkeke II	community leader[3]	1	community leader

[1] The system's last ulu-ulu ceased his responsibilities in 1965.
[2] Leader of an agricultural farmer group.
[3] In Indonesian, the term is tokoh masyarakat, which denotes respected community members, including large landowners, elders, and hajjis, who have strong economic or moral standing.

agent to schedule water delivery to support the program.

Results and Long-term Impact

This section examines HPSIS's institutional, engineering, and agricultural accomplishments and their continuity both immediately following project conclusion and at the time of the reassessment, roughly five years later.

Institutions

HPSIS had little, if any, long-term institutional impact in the study sites. Despite several years of GOI efforts to create and sustain new management entities in the HPSIS systems, farmers clearly demonstrated their reluctance to participate in and sustain the P3As much beyond the time a community organizer was in place working with them. Following project implementation, there were no meetings or other P3A activities. The P3A collects no fees, and officers are not paid a salary or honorarium. Administrative files of the P3A have disappeared or are inactive, and the only relic of the P3As in most systems is a guest book, which is pulled out when visitors come to P3A offices. These offices, a holdover from the days of HPSIS implementation, play no active role.

Once the COs left the systems, farmers either quickly reverted to the arrangements they had in place previously or adjusted by ceding responsibility to village or local government entities. Table 25 indicates that in most cases farmers returned to their previous arrangements with little disruption and surprising continuity. The West Java and NTB systems show the least change. Often, even the same number of units in a system were retained. In South Sulawesi, where traditional leaders like the mandor uwae and mandor jene were already losing ground, there has evidently been a shift to greater responsibility for informal leaders and village government officers and away from farmer leaders operating exclusively in the irrigation domain.

Farmers returned to preproject arrangements to manage irrigation O&M, particularly in the tertiary system. The involvement of PU in small-scale irrigation development and main system management, begun earlier during the Sederhana Project, has been far longer lasting. Table 26 indicates those parties with lead responsibility for major irrigation activities. The pattern of the division of responsibilities among farmers, village government, and GOI is surprisingly regular in the systems: an overall division of responsibilities for main and tertiary system O&M has taken hold. This pattern is evident in the Sederhana sites, so it is difficult to attribute the division largely to HPSIS.

Although these functions are outside their formal responsibilities, farmers in all 10 systems continue to participate in main system operation and maintenance. This involvement may result from constraints on PRIS staffing, as in Cumanggala, where the PRIS officer also supervises six other systems. As a result, the ulu-ulu distributes water in the main system. Farmers in Leang-Leang have repaired the dam and those in Kocikang and Taretta have repaired the main canal. Farmers in Penimbung Kiri clean the main canal annually prior to the November planting.

HPSIS's greatest long-term impact has undoubtedly been upon the thinking of PU headquarters staff and provincial officers. When HPSIS was first designed and implemented, the community organizers program was an experimental approach to secure greater farmer participation in O&M. That program has now proven itself sufficiently to PU, which believes that the CO function must be an integral part of the future development of small-scale systems. Issues presently under discussion and nearing resolution concern who may best play that role, but the necessity and effectiveness of that function is not at issue.

Physical Infrastructure and O&M

HPSIS emphasized system management improvement rather than physical infrastructure development, with the exception of those systems that lacked permanent main systems, including Muncan and Taretta. Dry season irrigation in the sites was disappointing because of initial poor site selection and problems arising soon after construction was completed (see Table 27).

In Muncan, Leang-Leang, and Taretta, the actual irrigated area decreased after project implementation; in both Muncan and Taretta, sections of the main canal were buried under a landslide during the first year of the systems' operation. In Kocikang and Leang-Leang, farmers can grow only a single wet paddy crop per year because the source of irrigation water is rain-fed rivers, and no water is available in the dry season. Another contributing factor in Kocikang and Leang-Leang was a misconception about the water requirements: the design called for 1.2-1.8 lps, but the sand and rocky soil conditions demand four to five times that amount.

In Biangkeke II, before HPSIS the actual irrigated area was only 10 hectares. During HPSIS, the Department of Agriculture sponsored the development of a new rice field of 101 hectares; however, inadequate water reduced the area that could be cultivated to only 22 hectares in the wet season.

In the dry season the Cumanggala system irrigates only 40 hectares; the rest is irrigated by a different system. In the Taretta site, there is enough water to plant rice in the dry season, but farmers prefer to plant the more profitable tobacco.

The present condition of system structures in the HPSIS sites was examined and rated during the study (Table 28). As with the Sederhana sites, those in NTB are in the best condition (76 percent on average). The West Java sites averaged 68 percent, and those in South Sulawesi 65 percent. The structures in the HPSIS sites did not appear to be in significantly better condition than those in the 10 Sederhana study sites.

Since the completion of HPSIS, there have been continuing investments to complete, rehabilitate,

Table 26

Current Responsibilities for Irrigation Management in HPSIS Study Sites

Systems Activities	West Java		NTB				South Sulawesi			
	Cumanggala	Cikamal	Penimbung Kiri	Mencongah	Bilikere	Muncan	Kocikang	Biangkeke II	Leang-Leang	Taretta
Fee collection										
a. Salary	1	–	2	2	2	2	–	–	–	–
b. IPEP	–	–	–	–	–	–	10/11*	10/11	10/11	10/11
Distribute main system water	1	11	10	10	10	10/11	11	11	11	11
Distribute tertiary system water	1/6	6	2	2	2	2	4/6	6	4/6	6
Repair main system	9	9	9	9	9	9	9	9	9	9
Repair tertiary system	1/6	8/6	2/6	2/6	2/6	2/6	6	6	4/6	5/6/7/8
Clean main system	1/12	11	12	12	12	2/12	12	12	12	12
Clean tertiary system	1/6	8/6	2/6	2/6	2/6	2/6	4/6	6	6	6
Decide cropping pattern	10/1	10/13	10/1	10/13	10/13	10/13	3/10/13	5/10/13	10/13	10/13
Resolve conflict	1/6	8/6	2	2	2	2/7	7/10	5/10	7/10	7/8/10

*In September 1990, PU created P3As again in Kocikang for the purpose of collecting the IPEP. Each of the P3As has 15 blocks. A block has 20 farmers and covers 15 hectares. It is too early to determine the effectiveness of the program.

Farmers and farmer groups
1. Ditch tender (Ulu-ulu)
2. Subak and Pekasih
3. Village elder (Pinati)
4. Farmers group (Kelompok tani)
5. Informal leader (Tokoh masyarakat)
6. Individual farmer (Petani)

Village government
7. Village head (Kepala desa)
8. Sub-village head (Kepala dusun)

Government of Indonesia
9. Provincial Irrigation Service/PRIS (PU Pengairan)
10. PRIS officer (Juru pengairan/Kepala subranting)
11. Gatekeeper (penjaga pintu air)
12. PRIS laborers (Pekerja harian tetap)
13. Agricultural extension agent (PPL)

Table 27

Actual Irrigated Areas in the Study Sites Before and After HPSIS (ha)

Site	Before HPSIS	After HPSIS	
		Wet Season	Dry Season
West Java			
Cumanggala	178	191	40
Cikamal	162	226	226
West Nusa Tenggara			
Mencongah	211	257	257
Muncan	334	26	26
Bilikere	164	380	380
Penimbung Kiri	247	247	247
South Sulawesi			
Leang-Leang	572	193	40
Kocikang	242	242	0
Taretta	337	192	7
Biangkeke II	10	22	15

Table 28

Condition of the Structures in the HPSIS Sites

Site	Type	Condition (%)
West Java		
Cumanggala	SM	61
Cikamal	SDM	75
West Nusa Tenggara		
Mencongah	SM	80
Penimbung Kiri	SDM	80
Muncan	SD	67
Bilikere	SDM	78
South Sulawesi		
Leang-Leang	SM	60
Kocikang	SDM	65
Taretta	SD	65
Biangkeke II	SDM	70

and repair systems. Most of these structures were originally constructed during Sederhana.

In Kocikang, where the system works only during the wet season, O&M is done once a year. Since there is no water in the system during the dry season, no maintenance is done. Thus, the system has deteriorated more quickly than expected.

Cikamal and Bilikere are in the Efficient Operation and Maintenance Project, and they received substantial investment from the government. Even

so, their structures do not appear to be in appreciably better condition than those in Mencongah and Penimbung Kiri.

A regression analysis, conducted to relate water sufficiency and availability to physical condition in each of the HPSIS sites, showed little correlation between the two (Table 29). The correlation coefficient is only r = 0.10. This situation differs markedly from that in the Sederhana villages, where the physical condition of the system could be explained to a large degree by the water sufficiency and availability. Clearly, in the HPSIS systems, other intervening factors are more important. Among these factors is the incidence of natural accidents, such as landslides in Muncan and Taretta, which put maintenance and repair beyond the resources of both PRIS and the farmers. In these cases, little of the system was actually used and much fell into disrepair over time. The presence or absence of active water users groups has also influenced system maintenance, as other sections in this report elaborate.

Since the conclusion of HPSIS, there have been sustained system investments in the form of cash and labor contributions by the government and farmers (Table 30). Cash contributions by farmers were relatively small, with the exception of Taretta. When the Taretta construction was completed in 1984, 337 hectares could be irrigated in the wet season. However, the main canal collapsed in 1987, and the irrigated area dropped precipitously to 60 hectares. At the initiative of the village head, each farmer contributed Rp. 50,000 to repair the canal, for a total of Rp. 4.8 million. As a result, farmers were able to bring the irrigated area up to 192 hectares. Farmers in Taretta have a good income source in tobacco, which is a high-value crop requiring less water than wet paddy. By having made small improvements in the system (e.g., lining the tertiary canal and constructing a quaternary canal), farmers were able to increase the tobacco area.

Agriculture

Cropping patterns in the study sites changed little after HPSIS (Table 31); the dramatic changes had already occurred following Sederhana. Detailed cropping patterns of each HPSIS site are presented in Appendix G. In the main system, cropping

Table 29

Relationships Between Water Sufficiency and the Physical Condition of HPSIS Sites

Irrigation system	Rate (X)	Physical condition (Y)	Result/Correlation between X and Y
West Java			
Cumanggala	16	61	Y=65.3 + 0.28X
Cikamal	18	75	r=0.10
West Nusa Tenggara			
Bilikere	12	78	
Muncan	15	67	
Mencongah	17	75	
Penimbung Kiri	17	80	
South Sulawesi			
Kocikang	16	65	
Leang-Leang	14	60	
Taretta	17	65	
Biangkeke II	15	70	

Table 30

Investments in the Study Sites After HPSIS

Site	Type of Investment	Government		Farmers	
		Contribution (Rp. 000,000)	Year	Contribution (Rp. 000,000)	Year
West Java					
Cumanggala	Repair of weir and canals		1990	labor, .78	1987-90
Cikamal	Repair of main canal, dam, and off-takes	16.6	1988-90	labor, material	1989
West Nusa Tenggara					
Mencongah	Repair of canal and culvert	labor, material	1990	labor, material	1986, 1989
Muncan	—				
Bilikere	Repair of canals	labor, material (amount NA)	1986, 1988	labor, .63	
	New construction of intakes, animal bridges				
Penimbung Kiri	Canal repairs	labor, material	1986-88, 1990		
South Sulawesi					
Leang-Leang	Lining of primary canal	5.0	1986		
Kocikang	Repair of canals, dam floor			labor	
Taretta	Lining of main canal, construction of lined tertiary canal	amount NA	1989, 1990	labor, 4.8	1989
	Rehabilitation of tertiary canal	amount NA			
Biangkeke I:	Dam construction	13.0 by MOA	1986		
	Main canal lining	4.2	1987-90	labor, material	1988
	Main canal repair	5.0			

Table 31

Cropping Patterns in Study Sites Before and After HPSIS

Site	Before HPSIS	After HPSIS
West Java		
Cumanggala	Rice-Rice+Fish-Fallow	Rice-Rice+Fish-Fallow
Cikamal	Rice-Rice+Fish+Fallow	Rice-Rice+Fish+Fallow
West Nusa Tenggara		
Mencongah	Rice-Rice-Palawija	Rice-Rice-Palawija
Muncan	Rice-Palawija-Fallow	Rice-Rice-Palawija
Bilikere	Rice-Rice-Palawija	Rice-Rice-Palawija
Penimbung Kiri	Rice-Rice-Palawija	Rice-Rice-Palawija
South Sulawesi		
Leang-Leang	Rice-Fallow	Rice-Fallow
Kocikang	Rice-Fallow	Rice-Fallow
Taretta	Rice-Tobacco-Fallow	Rice-Tobacco-Palawija
Biangkeke II	Rice-Rice-Fallow	Western area: Rice-Palawija-Fallow Eastern area: Palawija-Rice-Fallow

patterns upstream, midstream, and downstream may differ because of water availability and soil variations. Some of the study sites display differences in cropping patterns based on location in the system.

In Cumanggala and Cikamal, however, there is no difference in cropping pattern among upstream, midstream, and downstream areas. Water in the dry season is sufficient to plant rice in all three sections. The availability of water in the dry season also has enabled farmers to raise fish before planting rice for one month after leveling the land.

In Mencongah, also, there is no variation among the three sections. The major palawija crop is soybean. Although there was no change in cropping pattern, upstream area increased 14 percent, midstream 15 percent, and downstream 24 percent.

In Leang-Leang, only 40 hectares located upstream were planted in soybean during the dry season. In 1990, through water pump irrigation from private sources, farmers pumped groundwater during the dry season into the canals, enabling them to plant rice on 100 hectares. Water pumps operated from one month before until two months after planting rice. The pump owner received one-quarter of the rice harvest from each farmer.

Cropping patterns in the 10 HPSIS sites have not changed appreciably over the last five years. Changes in rice yield before and after HPSIS concluded are shown in Table 32. Farm management practices introduced during HPSIS have been sustained. Most farmers in the study sites still plant high-yield varieties resistant to the leafhopper pest (IR-64, IR-42, and IR-36). Farmers in the sites apply somewhat more fertilizer than the PPL proposes, on average using 300 kg of urea, 100 kg of TSP, and 50 kg of KCl per hectares as compared with the suggested levels of 200 kg of urea, 100 of TSP and 50 kg of KCl.

Table 32

Rice Yields in the Study Sites (Dry Grain)
(tons)

Site	Before HPSIS	After HPSIS	
		Wet Season	Dry Season
West Java			
Cumanggala	2.9	4.0	3.4
Cikamal	2.5	4.5	4.5
West Nusa Tenggara			
Mencongah	3.1	4.2	3.3
Muncan	2.8	3.4	3.6
Bilikere	2.5	3.5	3.3
Penimbung Kiri	2.8	3.8	3.6
South Sulawesi			
Leang-Leang	1.5	3.1	2.4
Kocikang	2.0	3.4	0.0
Taretta	1.8	3.4	3.0
Biangkeke II	2.8	3.0	3.4

6

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Sustainability

In the context of this reassessment of the Sederhana and HPSIS Projects, the term *sustainability* refers to the continuity of those innovations introduced during project implementation. The focus is on identifying still-operating institutional and farmer behavior, formal and informal organizations, agronomic practices, and physical infrastructure that are directly attributable to project interventions.

Findings about sustainability, using this definition, are as follows:

- P3As created in the systems examined have not been sustained. With a single exception, the government-sponsored farmer organizations did not continue much beyond project implementation or other PU efforts. The exception is the P3A in a Lombok system, developed by Sederhana, where no irrigation had been conducted previously and no farmer organizations existed.

- P3As have not been sustained at the field level, but the GOI has held to the position that P3As are needed and are a critical part of irrigation management efforts. Although the nature of the CO effort is still to be determined, GOI commitment to the concept has been sustained.

- Farmer investment in both main and tertiary systems has been sustained, despite government policy that farmers are responsible only for O&M of the tertiary system. In areas where there are PU staffing constraints, farmers have continued to play a key and sometimes determining role in the operation of the main system.

- PU and PRIS interest in and commitment to small-scale irrigation has been sustained: PRIS is a continuing and important presence in the systems examined. Sederhana marked the government's first intervention in small-scale irrigation, and during the ensuing years, PRIS staff have continued to be involved in the systems, regulating water delivery and supervising overall main system maintenance.

- The physical infrastructure of the systems examined has largely been sustained, although perhaps not at the level expected or desired by PRIS staff. Still, all of the systems are in operation despite the condition of individual structures.

- Farm management practices introduced by HPSIS have been sustained, even though their link to improved water management has continued to be inadequate.

An assessment of sustainability also focuses on the persistence of pre-existing behaviors, activities, and institutions despite project interventions that seek to change or replace them. Examination of the long-term impact of Sederhana and HPSIS projects revealed the persistence of indigenous institutions despite significant government interventions to introduce new organizations. These organizations (subaks in Lombok) and leaders (ulu-ulus in West Java) have continued their roles in irrigation management. Those roles may have changed in some cases, but they have not been marginalized despite government attempts to replace them.

The findings suggest that where indigenous organizations and leaders were active prior to project implementation or other government efforts, they have continued and retain their importance. However, where they were already weak and were being replaced, as was the case with the mandor jene and mandor uwae on South Sulawesi, it was village government and not the P3A that filled the void and took on the added responsibility of managing the irrigation system.

Privatization

With respect to irrigation management, *privatization* is generally defined in terms of the transfer of system ownership to water users. Thus far, the GOI has not expanded its turnover policy to transfer of O&M management responsibilities to farmers to include their actual ownership of the system's physical assets. This reassessment of the Sederhana and HPSIS experiences indicates farmer capacity to fully operate and maintain the tertiary system and to draw upon their own resources to operate the main system when PRIS cannot.

Institutions

Project efforts have not led to sustained O&M practices. In JaBar and NTB, the O&M situation has returned to the preproject situation in which the ulu-ulu or pekasih supervised O&M. In SulSel, farmers are limited to activities in the tertiary system but do not need to organize into formal groups to manage it.

P3As were far less successful than anticipated. With a single exception, those created with or without CO assistance lasted little beyond project implementation. The one that did remain active was in an irrigation system first developed under the Sederhana Project, so there was no already-existing irrigation organization to compete with it.

Farmers do not necessarily need to belong to a water users group to effectively manage the tertiary system. Where water is insufficient, they may need an organization; where it is sufficient, a water master may be enough.

The P3As were less successful for a variety of reasons:

- They were frequently started just as the COs were completing their assignments and leaving the systems.
- They were organized with little or no attention to existing irrigation-based organizations and/or leaders.
- They were established through a limited number of farmers (kepala desa, prominent farmers).
- They were organized only to carry out the instructions of the government.
- They were too formal, too structured, and too open. Decision-making was encouraged in open meetings at which farmers were reluctant to speak freely.
- The GOI did not provide a mechanism for assisting farmers after the COs left the system.

Farmer involvement in P3As was stronger in SDM than in SD or SM sites. In SD sites, P3As were formed after construction and shortly before COs left the systems. Farmer participation was very limited.

Even though HPSIS failed to meet expectations, the CO program it initiated was an innovative attempt to grapple with strengthening water users groups, a difficult irrigation management problem.

The role of the COs in predesign, design, and construction was important, as they relayed farmers' ideas to contractors/PU and back, serving as liaisons.

P3As were nominally functioning in O&M when COs were present but they collapsed when the COs

left because the COs had not established sustainable O&M programs. With no clear, agreed-to responsibilities, the P3As served little purpose in O&M activities.

Physical Infrastructure and O&M

Maintenance in the Sederhana study sites was better in areas of less water sufficiency and availability because farmers were more dependent on efficient water delivery and distribution. In the HPSIS systems, there is no discernible relation between water sufficiency and system maintenance because of several uncontrolled factors, including natural calamities.

In areas where water was sufficient, PU investment in the physical system appears to have been greater than warranted. Simpler structures would have been sufficient, and quaternary structures were unnecessary.

PRIS and farmers share costs of system maintenance, but there is no apparent relationship between the level of farmer investment in labor or materials and the presence of a farmer organization. This suggests that continuing farmer investment in the systems does not depend upon the existence of a formal water user organization.

Agriculture

Farmers made use of increased water immediately by changing cropping patterns and increasing cropping intensity.

Increased water does not lead necessarily to more land coming into cultivation because of limits on suitable land and on funds for land development.

Agricultural practices introduced during HPSIS implementation by COs and PPL have been sustained and are still used by farmers, but better water management practices were not introduced. HPSIS made a positive contribution to farm management practices, but it did not relate them to better water management.

Recommendations

GOI investment in small-scale irrigation systems should be concentrated in water-scarce systems where water distribution is a problem. In systems with water sufficiency and availability, the government should consider limiting investment to main system development and rehabilitation. In systems where water is sufficient but unevenly distributed, permitting only wet season cultivation, as in the SulSel study sites, the GOI should focus on O&M and drainage to avoid floods.

Designs for system development and rehabilitation should be made by PU and farmers working together. Farmers should be included in initial field inspections and plan reviews and should have an inspection role during construction.

Where there are strong, traditional irrigation organizations or leaders, the GOI should work through them rather than creating new entities or drafting new leaders. When there are no existing indigenous groups or leaders, the GOI should determine why none exist and whether they are needed. Major institutional interventions such as the introduction of new local organizations, should be recognized as requiring long periods of time and scarce financial resources. These interventions should be considered only when no other alternatives exist.

The structure and organization of new water users groups should be defined by provincial or district authorities. The GOI should commit resources at the provincial and district levels to design, implement, and monitor a waters users program.

To make the water users group more viable—

- The COs should first visit all farmers individually to explain the objectives and functions of the P3A before calling a general meeting.

- The members should decide among themselves how they would like the water users group

organized, what leadership positions the group needs, and what the members' responsibilities should be.

- Leaders should be elected by the members instead of being selected by the kepala desa or other influential villagers.

- The water users group should have sole authority over water allocation in the tertiary system.

- Main system water distribution should be scheduled cooperatively by the juru pengairan and representatives of the water users group.

- Training for group leaders should emphasize organizational and administrative capabilities and O&M.

- The CO function should be continued, but the GOI should recognize that the program will take time before it yields the desired benefits. The program will require constant monitoring and refinement before appropriate models are identified. The GOI should be prepared to commit itself to a long-term effort if the CO program is to be successful.

- The CO program needs to be better linked to the kabupaten. A permanent government employee in each kabupaten should be appointed as the program supervisor, coordinating CO programs and the activities.

APPENDICES

A

SCOPE OF WORK

STUDY OBJECTIVES

During the period 1975 through 1985 the United States Agency for International Development (USAID) provided assistance to the Government of Indonesia to implement a series of projects for building and improving small-scale irrigation systems throughout Indonesia. The activity was known as the Sederhana Program, and in its later stage as the High Performance Sederhana Irrigation Systems (HPSIS) Program.

This special study will re-examine a selected number of the sub-projects (irrigation systems) implemented by both the Sederhana and HPSIS Programs. The major purpose of the study is to understand the current situation in these irrigation networks with regard to:

- the organizational arrangements and processes through which the systems are sustained,
- agricultural production activities, and
- the pattern of investment in the irrigation system, both local and external, since project completion.

The special study is intended to provide information with direct relevance to and application in the current Small Scale Irrigation Management Project (SSIMP) being supported by USAID. It is expected that results also will be cogent for broader GOI irrigation initiatives such as the re-arrangement of institutional responsibility for everyday O&M activities in small public systems now being explored through pilot turnover programs.

In particular, this special study will yield important insights regarding the sustainability of these sub-projects assisted through the Sederhana/HPSIS programs. The field data to be collected will be the basis for formulating conclusions regarding the extent to which sustainability has been achieved in organizational, technical, and agricultural terms and the contextual factors related to sustainability. The 20 systems to be studied will vary with regard to their post-project age, size of the irrigated area and whether or not they were part of the pilot project that utilized community organizers.

THE STUDY DESIGN

The research design to be used is the multiple case study approach using qualitative research techniques such as key informant interviews, field observations and examination of secondary records and other data. A total of 20 case studies will be conducted—each case will deal with an individual sub-project (or irrigation system) built or improved under the Sederhana/HPSIS Programs. These 20 cases studies also will be used to produce a summary report and a set of cross-case conclusions and recommendations for action.

The 20 case studies will cover both HPSIS and non-HPSIS sub-projects in three provinces in the following pattern:

West Java	2 HPSIS locations 2 non-HPSIS locations
South Sulawesi	4 HPSIS locations 4 non-HPSIS location

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NTB 4 HPSIS locations
4 non-HPSIS locations

The 10 HPSIS locations to be studied include the total universe of HPSIS projects in these three provinces.

The 10 non-HPSIS locations represent only a small fraction of the total number of Sederhana sub-projects implemented in these provinces. These 10 locations will be purposively selected to represent variation in "age" of the project, size of irrigation service area (a few sites should be greater than 500 hectares in service area), variations in project success and general proximity to the HPSIS locations (for reasons of logistical simplicity).

The selection of these 10 non-HPSIS locations will be done by the USAID staff in cooperation with the Provincial Irrigation Staff in each of the three provinces. The research team will be provided this list by USAID. In selecting these Sederhana systems the following criteria will be used:

1. Wherever possible locations will be selected in the same kabupatens in which HPSIS sites are located to simplify logistical arrangements,

2. To achieve the purpose sampling noted above, the 10 Sederhana sites also will be selected as follows:

— approximately half of the locations should have been completed before 1980,

— in each province one location should have a designated service area of more than 500 hectares, and

— in each province one location should be a sub-project considered by Public Works to have significant technical and/or organizational problems.

The overall study will be conducted in three phases:

Phase 1: Initial start-up activities and the completion of the 4 case studies in West Java. At the completion of these case studies there will be a review of the study procedures and results to identify any needed modifications in approach before beginning the Phase 2 activities.

Phase 2: Start-up activities for the research in South Sulawesi and NTB and the completion of 3 case studies in each of these provinces.

Phase 3: Analysis of results from the 20 case studies and the preparation of a final report summarizing the findings; identifying conclusions and stating recommendations for action. Presentation of the study findings to USAID and GOI.

Professor Coward of Cornell University will be available to work with the research staff at the time when the West Java field data is being reviewed and preparations for Phase 2 are underway and again during the analysis work and writing of the final report (Phase 3).

DATA TO BE COLLECTED

For each of the 20 study locations data will be collected to cover the five areas discussed below. Additional detail on the information to be collected is discussed in the next section concerning data collection procedures and sources of information.

At each research location multiple sources of information will be used:

a. on-site observations by members of the research team (for example, examination of the irrigation structures, observation of the cropping patterns, attendance at farmers' meetings, if possible, and so on),

b. with the use of interview guides, interviews with key informants including local government officials, local agency staff (the juru pengairan and PPL, for example), irrigation leaders (both P3A officers, if any, and traditional irrigation leaders) and ordinary farmers, and

c. relevant records such as the minutes or records of labor or other local resource contributions that the P3A (or traditional irrigation organization) may maintain, village government records dealing with population and land ownership patterns and kabupaten records providing information on average household incomes and other topics.

1. Background information:

This will cover basic information required such as: 1) the administrative location of the project (including the specific villages involved), 2) the water source being used and the general nature of its hydrology, 3) the location of the irrigation project in the river system of which it is a part (what other systems are above or below it on the same river course) and 4) a description of the timing, activities and cost of the previous Sederhana/HPSIS program in this location.

The background information also should include any pertinent data available regarding system operation and management and organization arrangements in the system at an earlier time, including the pre-Sederhana/HPSIS situation, as reported in any available studies or reports. Previous information on the technical facilities, hectarage irrigated (per season), cropping patterns and organizational arrangements for irrigation should be used for comparisons with the present situation.

2. Present status of physical facilities:

This information should cover the present status of all significant structures in the system from the diversion structure through the distribution system. Attention should be given to the present status of all existing structures both those built by the government and those built by the farmers (or built jointly). For each, structure information should be recorded regarding its condition and whether or not it is being used. For those structures that are not operating an assessment should be made of the capacity of the local farmers to make the necessary repairs. Also, information on plans for rehabilitation of these broken structures by Public Works or any other agency should be obtained. For those structures that are operable but are not being used, information should be gathered on why this is the case. Information on farmer-built structures should be included even if the structures are made of local materials. The same applies for information regarding the various canals in the irrigation network.

Information should be reported on current versus design hectarage for both wet and dry season operations.

3. Cropping patterns and agricultural practices:

This topics includes detailed information on the cropping patterns being followed in various sections of the system (head, middle and tail areas). A detailed crop calendar should be prepared. Estimates of crop yields should be obtained from key informants and cross-checked PPL records, if possible.

Also, information regarding the use of production inputs should be given to identifying any differences in cultural practices or use of inputs in different sections of the irrigation system which may be related to soil variations or problem water supply situations.

Whenever possible, comparisons should be made between the present agricultural practices and those reported for the pre-project situation or for an earlier period following project completion.

4. Current organizational arrangements and decision-making:

This topic includes information on the organizational structure or organizational arrangements in the irrigation system, formal or otherwise, for handling basic irrigation tasks such as water distribution and system maintenance. A

discussion regarding the actual current functioning of the P3A, if any exists, should be provided—identification of the offices, percent of potential cultivators involved in the group, important activities of the groups such as maintenance and water distribution activities. This information should focus on what the irrigation group is actually doing and no on the "ideal" arrangements and procedures.

In addition to a discussion of the structure of this local organization, information should be provided on the actual processes used for decision-making—especially decisions that affect sustainability, such as resource mobilization and contacts with other important groups such as village government and various technical agencies.

5. Investment history since project completion:

This topic includes information on the investments that have been made to further develop, or to make significant repairs to, the irrigation network (the diversion structures, the canal network, various distribution structures and so on). Two sources of such investment are to be considered. On the one hand, this covers local investments made by farmers themselves (perhaps in combination with resources provided from the outside). This local investment might involve cash contributions through the P3A or otherwise and also includes labor and materials that may have been provided.

On the other hand, the system may have received financial or other assistance from various government agencies and funding sources such as Public Works, Agriculture, subsidi desa funds, the office of the Bupati and so on. Such external assistance may have come in the form of cash, materials, technical assistance and so on. A careful recording of such assistance is required to identify the following.

- exactly what assistance was provided
- by what agency
- in what year(s)
- at what cost?

IMPLEMENTATION PROCEDURES

1. Initial Start-Up Activities

There are several activities to be undertaken in this initial start-up period in preparation for project implementation. These include the following:

a. Interviews by the senior researchers with individuals and agencies previously involved in the Sederhana/HPSIS programs to acquire background and understanding of the objectives and procedures used in implementing both Sederhana and HPSIS. This includes staff from Public Works, Agriculture, LE3ES, Ford Foundation and USAID.

b. A mini-workshop (perhaps 2-3 days) to involve the senior researchers, the Field Coordinator and the 4 Field Assistants for West Java meeting with Indonesian and other researchers experienced in conducting research similar to that to be undertaken herein. Examples of such persons are Dr. Richard Hutapea of Satya Wacana University, Bandung staff of the International Irrigation Management Institute (IIMI), Jakarta staff of LP3ES and the Ford Foundation. The objective of this mini-workshop will be to acquaint the research team with the on-going work of others, the research methodologies they are utilizing and the tools for data collection that they have created.

c. Following the completion of the mini-workshop a specific training and planning program will be organized by the senior researchers and the Field Coordinator for the field assistants to prepare them for their data collection activities in the case study locations. At this time, interview guides for use in interviewing key informants and other protocols for data collection will be developed by the research team.

A similar training and planning activity will be required for the field assistants hired for work in South Sulawesi and NTB. In this session the research team will review the interview guides and other research instruments used in West Java for any needed modifications. This activity will occur

after the completion of Phase 1 and as part of the stat-up activity for Phase 2. This training might be done in Jakarta and could include visits to the West Java field locations.

Following completion of this joint training for South Sulawesi and NTB, field assistants field work will begin in the two provinces. To allow the senior researchers opportunity to assist the field assistants in beginning their work, the field work will begin in South Sulawesi one week before the start in NTB.

2. Pre-Field Work Preparation

Both Phase 1 and Phase 2 will begin with a review of background information available for the field locations to be studied. This work should be done under the direction of the senior researchers. There are two sources of information to be consulted: 1) the materials available with DGWRD or Pertanian that were prepared during the planning and implementation stage, including a system map and 2) information from previous studies. Before beginning field work in each location the research team will have assembled and reviewed this background information on the field locations.

3. Introductory Activities at Each Location

The research process at each site should begin with appropriate introductions by the Field Coordinator and the field assistants to the local government officials and knowledgeable agency staff (both Public Works and Agriculture). From these preliminary discussions there should be a preliminary identification of the local irrigation leaders which may be modified as the research team becomes more familiar with the local situation.

4. The Walk Through

The first step will be to conduct a careful "walk through" of the entire irrigation system beginning from the point of diversion to the tail of the system. The research team, using the system map and/or an accompanying list of structures built by the Sederhana/HPSIS program, should conduct this activity joined by several of the local irrigation leaders identified in the Introductory Activities step. During this walk-through notes should be recorded on the following:

a. The location and state of all structures—in the main, secondary and tertiary levels. Structures not shown on the map should be added to it. For each structure one should record the following: 1) location (keyed to the map), 2) type of structure, 3) built by whom and when (be sure to include farmer-built structures), 4) current condition (operable or not) and 5) whether the structure is actually used by the farmers or not. Photographs should be included to illustrate present conditions.

b. Condition of the main and secondary canals.

c. Crops being grown and their hectarage in the head, middle and tail sections of the system and information about crops grown and hectarage in these areas in other seasons (be specific about the seasons),

d. preliminary information on the system-level water rotation patterns followed in the different agricultural seasons.

5. Key Informant Interviews and Local Records

Using the interview guides, interviews with key informants, which may be either with individuals or with small groups, and review of relevant records, if any, need to be arranged to obtain information on the several topics discussed below. It often will be possible to discuss several of these topics in the same interview with a particular key informant. However, for purposes of presentation here the topics are discussed separately below:

a. Systems operation and water distribution:

Interviews with P3A officers or other information irrigation leaders, interviews with local water distributors (such as the ulu-ulu in parts of Java), interviews with farmers (both owner cultivators and

tenants) whose field are located in different parts of the system, especially the tail-sections.

From these interviews there should develop an understanding of the rules and procedures used for distributing water and who is responsible for doing what activities. It also is important to document any involvement of Public Works staff in these water distribution activities. Special attention should be given to understanding the arrangements that are used during periods of low water supply and water stress.

b. System Maintenance and Repair

Interviews with the same individuals as above, as well as, village officials (i.e. the kepala desa and the kepala urusan okonomi dan pembangunan) to determine if any village resources (such as subsidi desa funds) have been used for system maintenance or repair. From these interviews there should develop a clear understanding of the rules and procedures for mobilizing labor and other resources needed to maintain and repair the weir, canals and other structures in the system. Check for any differences in the requirements of owner-cultivators as compared to tenants. Detailed information on the amount of labor and other resources mobilized during the past two agricultural seasons should be collected and reported per season. It also is important to document any involvement of Public Works in these maintenance and repair activities—either funds or staff.

c. System development and improvement:

Interviews with the same key informants as above to determine what contributions farmers have made to the construction of new structures, new canals or other development activities. Also, interviews with the village officials to determine if any village resources (such as subsidi desa funds) have been used for system development. Also, through these interviews, and related interviews of the district government offices (such as PW, Agriculture and PemDa) to determine if any government projects have been implemented in the irrigation system for its development and improvement.

From this information the research team will create an investment profile that identifies all investments that have been made in the irrigation system since completion of the Sederhana/HPSIS activities. This investment profile should clearly identify what was done, who did it, in what year and the amount of the investment. Both government investments and investments by local people are to be included in the profile.

d. Organizational arrangements and decision-making:

Interviews with the P3A officials and/or those persons involved in local-traditional irrigation institutions such as the ulu-ulu or pekasih. A good source of information about organizational arrangements in the past and about current changes are former officers and traditional leaders.

Of special interest is to understand the present status of the PSA that was intended to be organized in these systems. If it is not functioning, or is doing so poorly, information is needed as to why this is the case. Also, if the P3A is not functioning we need to understand to what extent other local arrangements are substitutes for it.

From these interviews the research team will construct a picture of the organizational pattern for irrigation decision-making in the system including the relationship, if any, to other formal and informal organizations at the local level, such as the desa government, kelamook tani, kelompok adat and so on. Also through these interviews the research team should document the processes being used to make decisions and implement activities such as the mobilization of resources (labor, cash, materials and so on) for system maintenance, repair and development, devising and implementing water rotation when needed, interacting with government agencies to receive technical and financial resources. Related activities such as procedures for adopting

new policies or procedures (such as new rules for water distribution) and for selecting new officers should also be examined.

6. Preparation of Draft Case Study Report

Upon completion of the field data collection in each research location the field research team with assistance from the Field Coordinator will organize and compile the information into a draft case study. Details regarding the content and organization of the case study report are discussed in the section below (Research Outputs).

7. Review of Draft Report

Each of the Draft Case Study Reports will be reviewed by the senior researchers to identify any gaps, conflicting information, points lacking clarity and so on. Steps will be taken to correct any deficiencies. Especially important in this step is for the senior researchers to discuss the findings with one another to be sure that a comprehensive understanding of the situation has been achieved and that the critical interactions between the technical, agricultural and organizational dimensions have been identified. Time for this activity is provided at the end of both Phase 1 and 2.

8. Additional Data Collection and Final Case Report

If additional data is required this will be collected by a member of the research team before the field assistant leaves the location. The last step for each location will be completion of the writing of the final case study report.

9. Analysis of the Case Study Reports

There are three tasks to be performed in analyzing the case study reports: summarizing the findings, forming conclusions and developing recommendations.

a. Summarizing the Findings: The senior researchers will be responsible to review the 20 case studies and prepare a summary of the findings for each of the key topics: 1) the state of the physical facilities; 2) the agricultural activities; 3) the current organizational arrangements; and 4) the patterns of continuing investment. Wherever appropriate these summaries should include information presented in tabular form. For example, tables may be used to summarize information about cropping patterns, extent of double-cropping, labor mobilization by local groups, agency investments in the systems since project completion, and so on.

b. Conclusions: In addition to the summary of findings, the senior researchers also should prepare a discussion of their conclusions regarding the technical, agricultural and organizational sustainability of the systems and the factors supporting or constraining future sustainability.

c. Recommendations: Finally, based on the findings and conclusions, the senior researchers should prepare a list of high priority recommendations for consideration by USAID and the GOI regarding implementing future small-scale irrigation projects in ways that will optimize success and the achievement of sustainable conditions.

RESEARCH OUTPUTS

Research outputs will be required at two levels: a report for each of the 20 case study locations and an overall report summarizing the findings from the 20 case studies, stating conclusions and identifying recommendations for action. All reports are to be prepared in English.

These reports will be required at each of the 3 phases of work discussed above:

- 4 case study reports for the locations in West Java to be submitted at the end of Phase 1

- 16 case study reports for the locations in NTB and South Sulawesi to be submitted at the end of Phase 2, and

- the final report to be submitted at the end of Phase 3.

A. Case Study Reports

Each case study report should include the following:

1. A Cover Sheet with critical identification information such as name of system, location, year and amount of Sederhana/HPSIS assistance, size of area irrigated, and so on.

2. A simple sketch map of the physical layout of the scheme with the location of key components of the system. In most locations, this map can be developed based on maps available with Public Works.

3. The body of the case study will be composed of 5 chapters related to the 5 topics discussed above: 1) Background; 2) Current O&M organization and activities; 3) Assessment of the physical facilities and water source, 4) Cropping patterns and agricultural activities; and 5) Investment history since project completion.

Each chapter will present the findings based on the field investigations and deal with the major questions/points discussed above under the section: Data to be Collected. Where previous information is available on the particular location a comparison should be presented discussing any changes between the previous situation and the current status.

In short, each Chapter should present a clear picture of the present conditions of state of affairs relative to the topic being discussed.

B. Final Report

The final report should include the following sections:

1. Executive Summary: Briefly summarizes major findings, conclusions and recommendations in not more than a few pages.

2. Introduction: Reviews the purposes of the study, the research approach used and a summary of key characteristics of the 20 irrigation systems included in the study.

3. Summary of Findings: Summarizes findings across all the case studies, with respect to each of the 5 major topics reported for each case. Wherever appropriate, tabular information will be provided as discussed above.

4. Conclusions: This section will construct the major conclusions of the study regarding issues of organizational, technical and agricultural sustainability.

5. Recommendations: This chapter will present recommendations to be considered by USAID and/or the GOI in planning and implementing future small-scale irrigation development programs.

Professor Coward will work closely with the research team in the preparation of this final report.

TIMING OF ACTIVITIES

The total time required from initiation to project completion will be 31 weeks. An important assumption is that the field work required in each case study can be completed in a two week period.

Phase 1 is to be completed within 10 weeks. This includes the following:

Initial Start-Up Activities:	3 weeks
Preparation for field work:	2 weeks
Completion of 4 case studies with 4 field assistants:	4 weeks
Review and case finalization:	1 week

Phase 2 is to be completed within the next 15 weeks.* This includes the following:

Start-Up Activities:	2 weeks
Preparation for field work:	2 weeks
Completion of 8 case studies with 4 field assistants in South Sulawesi;	8 weeks
Completion of 8 case studies with 4 field assistants in NTB:	8 weeks
Review and case finalization:	2 weeks

Phase 3 is to be completed within the final 6 weeks. This includes the following:

Analysis of 20 Case Studies:	3 weeks
Preparation of Final Report:	2 weeks
Debriefings with USAID and GOI:	1 week.

*A total of 9 weeks is required to complete the field work in the two provinces since the field work in NTB will begin one week after it begins in South Sulawesi.

STAFFING

Four categories of key staff are required to implement this research activity: 1) senior research staff, 2) senior consultants(s), 3) field assistants and 4) administrative. Their responsibilities are discussed below:

1. Senior research staff: the following three persons are required:

a. Sociologist/Anthropologist: Experienced in conducting irrigation-related research and preferably with experience in using the case study (qualitative) research approach,

b. Irrigation Engineer: Familiar with the design and construction of small-scale irrigation structures and the operation and management of small systems,

c. Agronomist/Farming Systems Analyst: Familiar with irrigated agriculture and the production of both rice and non-rice crops.

The responsibilities of the senior research staff will be to:

- design the research procedures, interview guides and other protocols for data collection,
- train the field assistants
- coordinate and conduct the review of background information
- visit the field locations for purposes of first-hand data collection and supervision of the field assistants
- review the draft case study reports and prepare the final case study reports
- conduct the review of the Phase 1 activities and make any needed changes in research instruments and procedures
- analyze the results of the 20 case study reports and
- prepare the final project report

It may not be necessary for these three senior researchers to be fully engaged with the project during the entire 31 week period. However, if any of the senior researchers are part-time with this project they must be available at the strategic times required to effectively accomplish the above responsibilities.

2. Consultant: Unless the senior research staff includes a highly experienced sociologist/ anthropologist familiar with the use of case study techniques it is highly recommended that provisions be made for such a person to work with the senior research team at several strategic times during the research project including: Phase 1 activities such as the initial start-up activities and the preparation for the field work, during the time of field data collection and at the time of reviewing the results of Phase 1. In Phase 2 the consultant should participate in the training of the field assistants, visit

selected locations in each of the provinces. And, in Phase 3 the consultant should attend some of the discussions related to the analysis activities.

3. Field Assistants: Field assistants are required for field work in each of the 3 provinces (the work in West Java will be done in Phase 1 while the work in the other two provinces will occur simultaneously, but with one week lag for beginning the work in NTB, during Phase 2). Field assistants need to have prior rural research experience, appropriate language skills and be prepared to reside in rural areas during the research. A team of two field assistants will be assigned to each location: one person with social science training and one with irrigation engineering or agricultural training.

West Java: 2 teams of research assistants each are needed; each team will be responsible for 2 case studies

South Sulawesi: 2 teams of two research assistants each are required; each team will be responsible for 4 case studies

NTB: 2 teams of two research assistants each are required; each team will be responsible for 4 case studies.

4. Field Coordinator: In addition to the several research teams discussed above there is a need for a Field Coordinator who will be employed for the full period of the research project. This person should have had several years of experience in conducting field research and in supervising field researchers. This person will participate in all phases of the project and serve as the key link between the senior research staff and the field assistants teams. The Field Coordinator will also link with the project manager to ensure needed logistical support for the field assistants teams.

5. Administrative: An experienced program manager is needed part-time to be responsible for the logistical backstopping of the research program. Activities will include necessary coordination with appropriate government agencies at all levels, backstopping the research staff and arranging support staff for such tasks as data analysis and interim and final report production.

B

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D

DESCRIPTIONS OF THE STUDY SYSTEMS

LEUWI JUBLEG

The Leuwi Jubleg system in Cianjur district, West Java draws its water from a permanent dam on the Cisarua River. The largest of four systems located on the river, Leuwi Jubleg has a potential area pf 532 hectares. The system serves 324 hectares in the rainy season and 320 in the dry season; during the dry season, the system receives supplemental water from the Cisarua II Irrigation System.

Leuwi Jubleg irrigates wetland paddy fields for three villages, the major wet- and dry-season crop being wetland rice. The system was first developed by farmers who, inspired by a community leader, built a semipermanent dam and canal system.

The Sederhana project focused on Leuwi Jubleg during two periods: 1978-79 and 1982-83. First, Sederhana converted the dam and main system into permanent installations, including intake and spillway structures in the right wing. Second, the project developed the main and tertiary systems, including the intake and spillway structures in the left wing. A few structures were poorly placed during the Sederhana project and now cannot be used: for example, two drop structures were located too high for water in the system to reach.

Before 1981, system O&M was taken care of by the ulu-ulu, who was paid from the *tanah bengkok* or from other farmer contributions, called *pancen*. His role was limited to mobilizing the farmers to collectively work on system O&M and controlling dry-season water in the main system. O&M in the tertiary system was carried out individually by the farmers themselves. After 1981, the ulu-ulu was replaced by the head of Economic and Development Affairs, a village official. The replacement was based on the Ministry of Internal Affairs Decree No. 1/1981.

After the Sederhana project was completed, a juru pengairan was appointed for this system and three others. His job in Leuwi Jubleg is limited to taking notes on the planting acreage and checking and reporting system conditions to the PU. He also conveys the water shift schedule from the PU to the three villages irrigated by the Leuwi Jubleg system.

At present, there are three P3As on the books, but only Babakansari P3A—in the downstream area—is active. In the upstream and midstream area, farmers control the water themselves under the direction of the head of Economic and Development Affairs. During the dry season water is distributed among the three villages in shifts; however, the upstream village receives water during the day whereas the mid- and downstream villages receive water only at night and in alternate shifts. Water conflicts among farmers are resolved directly by the village government.

At the time of the study, irrigation structures in this system appeared to be in poor condition. About 62 percent of the structures were not functioning at all, 38.5 percent were heavily damaged, and about 61.5 percent were somewhat damaged.

CIBOJONGKAKAK

The Cibojongkakak system in Pandeglang district, West Java is the fifth of six systems located on the Ciatuy River. Water from the Ciceuning spring supplements that pumped from the river.

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The system was built by the Dutch in the 1920s, and has been used ever since. Its potential service area is 184 hectares, although the actual area served is 136.3 hectares. The main crop in both rainy and dry seasons is wetland rice. A farmer-managed system, Cibojongkak was improved in 1976-77 through the Sederhana project. Sederhana developed and constructed main and tertiary systems, including a permanent dam and intake structures, culverts, side spillway, and man/animal bridges.

Before Sederhana, a *mandor air* handled O&M in the main system and an *ulu-ulu* in the tertiary system. Users collectively carried out O&M activities in both systems, coordinated by the ulu-ulu.

After Sederhana, the PU appointed a *juru pengairan* of eight workers to take care of O&M in the main system. All had been involved in system construction.

A P3A was officially formed in 1989, but until recently no activities were carried out. The ulu-ulu controlled water flow while the individual farmers handled distribution of water into the fields. In this system, the role of the Cibojongkakak sub-village head was decisive because most of the large ricefields were downstream from the Cibojongkakak sub-village. The sub-village head initiated all O&M activities and also handled conflicts among farmers.

At present, the system is in fair condition. About 75 percent of the irrigation structures were still in good repair and functioning. About four meters of the main canal between Intake 1 and 2 was broken at the time of the study. Repairs have been made three times, either by the farmers or by the farmers and PU cooperatively, but this section always breaks during the rainy season. Three ulu-ulus were on duty, assigned upstream, midstream, and downstream within the system.

SINDANG GILA

The Sindang Gila system is located in Bayan subdistrict, West Lombok district, NTB. It is the first of three systems along the Sindang Gila River. The system has a potential area of 855 hectares of wetland paddy, in an area that before the Sederhana project used water from the Sindang Gila River for domestic use, upland agriculture, and shifting cultivation.

Sederhana worked with the irrigation system from 1980 to 1982, developing the main system, such as the dam, intakes, culverts, tunnels, syphon, animal bridges, etc., as well as the secondary and tertiary systems. Coordinated by the P3A, farmers developed their land, partly through UPP credits, into wetland paddy fields. This effort put 495.6 hectares into wetland paddy fields that are divided into 23 tertiary systems. The main crop in the wet season is paddy, while in the dry season farmers grow palawija because of porous soil and insufficient water.

After Sederhana developed the system, its water was regulated by the pekasih. In 1983, the government appointed a juru pengairan, assisted by two gatekeepers, and formed a P3A; pekasih responsibility was then limited to the tertiary system. In 1983, a P3A was formed and in 1985, another. P3As coordinate all system O&M.

The main problem in the system has been dry-season water scarcity, especially downstream. Because limited water entered the main canal, equity in water distribution was difficult. And because most off-take gates were temporary, distribution was difficult to monitor.

At present, about 90-95 percent of the irrigation structures are in good condition and functioning. The juru pengairan carries out system O&M, assisted by two gatekeepers. Main system maintenance such as canal and structural repairs are done by the farmers and P3A cooperatively; the P3A determines the cropping pattern, schedules planting, and distributes the water.

REMPEK

The Rempek system is located in West Lombok district, NTB. Its source of water is the Temuan

River through the Rempek dam, the larger of two dams on the river. Potential area is 654 hectares, while the actual area served is 179 hectares in the wet season and 177 in the dry. Sederhana developed the system in 1978-79 and in 1981-82.

Before the Sederhana project, O&M activities were carried out by the *subak* led by the *pekasih*. There was only one subak in the Rempek system. Pekasih activities are significant during the dry season, as the pekasih must distribute the water from the canal to the blocks. During the wet season, the pekasih needs only to control the water and monitor the system conditions. In case of any damage to the system, the pekasih will ask subak members to collectively work on it, usually prior to planting season.

Sederhana replaced the dam with a permanent structure and built some intake/off-take structures and main and tertiary canals. Project implementation was considered improper because in some cases the new structures were simply built on top of the old ones, which deteriorated and collapsed, destroying the new structures. After the project, a juru pengairan and two gatekeepers were appointed. The juru's role was to coordinate the two gatekeepers in the operation of the dam and intakes and to report water discharges, planting area, and system conditions to the PU. The juru also helps the pekasih control water delivery to the fields. After the project, the subak role remains that of controlling the water.

A P3A was established in 1987 but does not function as expected. In 1988, the pekasih cooperated with the juru pengairan to form eight quaternary farmer groups, each group with a leader assisted by a secretary, treasurer, and irrigation section head. In reality, only the group leader was active, and he was the only one to receive compensation from the members.

At the time of the study, about 40 percent of irrigation structures were heavily damaged—mostly canal dikes and drop structures. The dam is still in fair to good condition.

IRENG DAYA

Located in West Lombok district, NTB, the Ireng Daya system irrigates areas in two villages. Its water source is the Midang River by way of the Midang Dam, first and largest of three dams along the river. The potential and actual irrigation area is 253 hectares, on which farmers grow wetland rice in both wet and dry seasons.

Prior to 1975, the system obtained its water from two sources: Midang Dam and Ireng Dam. In 1985, however, the Ireng Dam was damaged and could no longer serve as a source of supplemental water. Water distribution from the remaining dam to the tertiary system was handled by a pekasih; farmers working collectively took care of system O&M.

The system was developed by the Sederhana project in 1976-77 and in 1978-79. During the project, a semi-permanent dam was located 500 m downstream from the old dam built by the Dutch government of piled rock. Also constructed were intake structures, drop structures, and the main and tertiary systems. The Ireng Daya system continued to draw supplemental water from Ireng Dam until 1985.

Although established by PPL in 1978, P3As carried out no activities. The pekasih or his associate continued to distribute the water from the main to the tertiary systems, and the farmers individually handled water flow to the fields. System O&M was the responsibility of the farmers, coordinated and led by the pekasih.

Three subaks and three pekasihs worked in the system, whose working area was based on a hydrological rather than administrative boundary. Sederhana restricted the pekasih's scope of work to the tertiary system only, and placed the main system under the responsibility of the irrigation officer assigned to Ireng Daya in 1977.

The system's structural condition is fair to good, with a little damage seen in the main canal and some dam leakages that were repaired with rock piles. Farmers had created three holes at the intake

to flow the water, considering the canal built by the project to be inappropriate. Canal maintenance and repair—usually done prior to the planting season—were carried out by the farmers, led by pekasih.

SIDEMEN

Sidemen, in Central Lombok district, NTB, draws its water from the Lenek Gresik River through Sidemen Dam and receives supplements from four other systems. Potential system area is 613 hectares, although the actual irrigated area is 470 hectares. The difference between potential and actual areas reflects the position of the main canal, which is lower than a part of the area to be irrigated. Farmers grow wetland rice in both wet and dry seasons.

Before 1975, five systems operated in the area: Selojan, Brore I, Brore II, and Rentung dams and an artesian well in Sintung village. Each system had its own subak and pekasih. The pekasih took care of water distribution from the dam to the tertiary canal, while the farmers themselves handled water flow to the fields. System maintenance such as dam repair and canal cleaning was carried out by the farmers, led by the pekasih.

Sederhana developed the system during 1976-77 and 1978-79. The project replaced the old dam (built by the Dutch government) with a permanent one and built intakes, drop structures, chutes, and main and tertiary canals. Subaks were not involved in the development, only the farmers as individuals. A P3A was established during this period, but no activities took place.

During project implementation, farmers made no compensation claims for land lost to canal construction because they understood the positive benefits of the project. The PU ssigned a juru pengairan, a dam watcher, and a gatekeeper to the system. The juru pengairan was to operate and maintain the main system, assisted by farmers through collective work.

Physical infrastructure at Sidemen is in fair to good condition: the dam is still in reasonable condition and functioning; 20 out of 23 chutes and other structures are functioning; and the main canal is still in good condition and functioning.

BULUMARAPA

Bulumarapa system is located in Maros district, South Sulawesi. Its source of water is the Bulumarapa River, via the Bulumarapa Dam, largest among three dams on the Bulumarapa River. The Bulumarapa system has a potential and actual area of 138 hectares located in two villages. Farmers grow wetland rice in the wet season and palawija or partly wetland rice during the dry season.

No indigenous farmer organization was associated with the system; farmers worked as individuals, delivering water to the fields that need it. The community leader or the village leader initiated the collective work when repairs were needed. The community leader also solved conflicts among farmers.

The Sederhana project was first implemented from 1975 to 1976, when a dam and earth canals were constructed. In 1981-82, a permanent dam was constructed, main and tertiary canals were improved, and intakes built. During the construction of the permanent dam, the contractor was changed because he was unable to finish the job. As a result, many workers were not paid, and some of the structures were improperly placed and had to be moved.

A P3A was formed in 1980 and a PU official assigned to the system, to be assisted by two gatekeepers and a dam watcher. The PU official visited the site once or twice a month to administer the planted area or the water discharge from the dam.

O&M for the tertiary system was carried out as before, because the P3A was inactive. Maintenance

such as cleaning weeds from the canals was done prior to wetland rice planting. In 1990, the PU official, assisted by the gatekeeper, implemented a weekly shift in water distribution between the left and right wings of the dam. The O&M of the main system was carried out by the gatekeeper.

System infrastructure system was about 69 percent good and functioning at the time of the study. About 19 percent of the structures were not functioning, 12 percent heavily damaged, and 19 percent slightly damaged.

PANYILI

The Panyili system in Bone district, South Sulawesi is the sole user of the Panyili artesian well, which feeds the Panyili system. Used only for domestic needs in the early fifties, well water began to be used for irrigation in 1969. With a potential area of 254 hectares, Panyili actually irrigates 97 hectares located in two villages. Farmers grow wetland rice in the wet season and palawija in the dry season because of limited water and also because palawija (especially soy beans) has higher value and an existing market.

Originally, the system had three irrigation workers, two of them village officials, who worked mostly in the dry season. Wet-season water was managed by the farmers themselves. Farmers paid about 5 kg of unhusked paddy per farmer per season to the workers. Maintenance such as canal cleaning was initiated by the workers and the village head (through the sub-village head), who asked the farmers to work collectively. Farmers delivered water to their fields, and maintained the tertiary system. System maintenance such as dam repair and canal cleaning were carried out prior to the planting season.

In 1977 and 1978 the Sederhana project built a reservoir, intakes, division boxes, and main canal. After this development, a juru pengairan was assigned to be responsible for main system O&M, but tertiary system O&M was taken care by farmers individually. Farmers delivered water from field to field through existing canals, sometimes reusing the drainage water for the lower fields. Now farmers can get more water than before, but they still grow palawija in the dry season.

The PPL formed four farmer groups in the system, one for each of the four tertiary blocks. The role of the groups in irrigation was to be relatively small, only tertiary canal cleaning initiated and led by the village head. Farmers would still deliver water to their fields individually. Main system O&M was to be carried out by the dam watcher and the gatekeeper.

At the time of the study, the reservoir and dam were still in good condition and functioning. About 50 percent of the intakes and other structures were in good shape, but 90 percent of the tertiary canals carried no water because farmers were using them to grow crops.

PANAIKANG III

Panaikang III is located in Bantaeng district, South Sulawesi. It takes water from the Panaikang River via Panaikang III Dam and receives supplemental water from the Cidi, Bira, Pasamen, and Paenre dams. The Panaikang III Dam was the first and smallest dam among the three dams along the river. With a potential area of 233 hectares, the system irrigates only 187 hectares because some of the area is higher than the dam and canal. The irrigated area is located in one village; farmers grow wetland rice in both wet and dry seasons.

In the 1960s farmers constructed a rock dam to be used for domestic needs. At that time, 84 hectares of wetland fields were irrigated by Paenre and Cidi dams. The village head managed water distribution, and the farmers took care of system maintenance when mobilized by the village head. In 1967, the Panaikang III Dam was damaged by flood and immediately repaired by the Bantaeng district government from the natural disaster funds. The dam was rebuilt by a

bronjong (gabion). Although PPL formed a P3A in 1978, no activity ever took place among the organizers or with farmers.

In 1981-82, Sederhana developed the Panaikang III irrigation system, constructing a main dam and three supplemental dams, intakes, chutes, spillways, culverts, and animal bridges. All of these structures were permanent. Contractors carried out Sederhana activities without ever contacting the farmers to gain their involvement. The farmers did not, however, seek compensation for lands affected by the new structures, due to the counsel of their village head.

After Sederhana, farmers built the canal system and expanded the wetland fields from the original 84 to 187 hectares. Water distribution is taken care of by farmers themselves except during times of water shortage, when a PU official steps in. PU has also assigned a dam keeper to operate and maintain the main system.

Overall, the system's present condition is fair to good. All but one of the main and supplemental dams are in good condition and functioning. Spillways, intakes, and other structures were in fair to good condition and functioning.

BIANGLOE V/VI

Biangloe V/VI system in Bantaeng district, South Sulawesi has the Biangloe River (through the Biangloe V/VI Dam), as its main water source and draws supplemental water from Balang Kura. The system, first established by the Dutch government when it constructed a rock dam, irrigates an area located in three villages. Potential and actual irrigated area is 697 hectares, planted to wetland rice in both wet and dry seasons.

Before 1977, water distribution was taken care by a mandor jene, with each farmer delivering water to his or her own fields. Maintenance such as dam repair and canal cleaning was done by farmers collectively.

The system was developed by the Sederhana project in 1978-79 and in 1983-84. During the first period, a dam and main canal were built, as were intakes and chutes. During the second period, the tertiary system was established. Water distribution was taken care of by the mandor jene and maintenance such as canal cleaning by the farmers, at the request of the mandor jene or sub-village head.

After the project, a PU official and dam watcher (replacing the mandor jene) were assigned to the system to handle water distribution and main system maintenance. Water distribution in the tertiary system was to be done by farmers individually and maintenance by the farmers collectively.

The dam is still in good condition and functioning, as are the chutes. Drop structures are 78 percent good and intakes 50 percent. The middle and downstream areas of the main canal are mostly broken but still functioning.

CUMANGGALA

The Cumanggala system in Cianjur district, West Java receives its water from the Cijambe River through Cumanggala Dam, the first and largest of seven along the river. The system was first developed in 1910 by farmers who built a weir of rocks and bamboo. Although the irrigated area of the Cumanggala system is 300 hectares, the actual irrigated command is 191 hectares in the wet season and only 40 in the dry season. The remainder receive water from other sources during the dry season. The major wet and dry season crop is wetland rice.

The system received Sederhana support from 1976 to 1978 and from 1979 to 1980, during which main and tertiary canals and intake structures, including a permanent dam, were constructed. HPSIS was implemented in the system from 1982 to 1985, covering the full life of the project. Cumanggala is a system management site that received assistance in P3A-strengthening activities.

In the 1960s, system farmers recruited as ulu-ulu one of the villagers who had no land himself but was the son of a landowner. He was responsible for allocating water and for system maintenance from the dam to the tertiary system. Farmers distributed water among themselves on the tertiaries, which they were also expected to maintain. During the Sederhana project, agricultural extension agents worked with farmers to establish a *mitra cai*. Committee members were elected, and the ulu-ulu was retained, with the additional role of ulu-ulu chairman, but his activities remained unchanged.

In 1982, because of the division of villages, community organizers entered the system and transformed the one mitra cai into three P3As that functioned nominally with the assistance of two community organizers. Little seemed to change in water distribution during HPSIS, with the exception of block ulu-ulus who were responsible for working with farmers in the tertiaries.

Within six months of HPSIS termination, the P3As became inactive and the two newly recruited ulu-ulus were no longer in those roles. Only the original ulu-ulu remained, now filling the vacuum and serving all system farmers again.

Five years after HPSIS, there has been a change in the management of the system. The ulu-ulu has expanded his responsibilities and now supervises operation and maintenance of both main and tertiary systems. Since HPSIS, system farmers have on a number of occasions repaired or improved structures without government assistance.

CIKAMAL

The Cikamal system in Pandeglang district, West Java drew its water from a dam in the Cikamal River. The dam, second on the river, is the third-largest among four located on the Cikamal River. The potential and actual area is 226 hectares: 162 hectares in Cimanuk village and 64 in Sekong village planted during both wet and dry season in wetland rice.

Until 1965, an ulu-ulu was responsible for controlling water and system maintenance, working cooperatively with village officials. Water distribution in the tertiary system was taken care of individually by the farmers. After 1965, the ulu-ulu no longer took part in system maintenance. Insteady, O&M was taken care by farmers who were mobilized by village officials to work collectively prior to planting season. During the Sederhana project, a juru pengairan was appointed, who worked also for another system. A dam watcher was appointed for Cikamal, as well.

The system was developed under the Sederhana project during 1979 and 1980. The project improved the simple dam—constructed by farmers from piled rocks—into a permanent one and developed the irrigation canals and other main structures such as intakes and drop structures. Through the HPSIS project, the system received guidance on P3A formation and tertiary system development in 1982-84.

The P3A was officially formed in 1984 during the HPSIS project, and the community organizer worked with the system for two years. The P3A was active during the development of the tertiary system. The association's ulu-ulu handled system O&M and also controlled water distribution from the main to the tertiary system. Simultaneous planting activities were successful during this period.

After HPSIS, the P3A's activities decreased, and farmers began again to manage water in the system. This was possible because of abundant water and a sloping and hilly topography that allows the drainage water from one system to be reused by the system below.

About 54 percent of the Cikamal irrigation structures were still in good condition, 16 percent slightly damaged, 30 percent heavily damaged, and 27 percent not functioning at all. Maintenance or repair of damages was not routinely done by the PU.

MENCONGAH

The Mencongah irrigation system, located in West Lombok district, NTB, draws its water from the Jangkok River. The irrigated area is located in but one village, Sigerongan. Although four dams serve Sigerongan, the Mencongah Dam irrigates the largest area. Although the potential area is 301 hectares, only 257.6 hectares are currently irrigated from Mencongah. The main crop in the wet season is wetland rice and in the dry, palawija.

Subaks handle water management. There are four subaks in the system, each with a pekasih. Water control and system maintenance are taken care of by subak members, who are coordinated by the respective pekasih. Many times during the wet seasons, the simple Mencongah Dam was washed out, and subak members repaired it under pekasih coordination. For carrying out his job, the pekasih receives compensation from the village in the form of a 40-acre piece of land. The subak collects 25 kg of dry, unhusked rice per harvested hectare from farmers.

Improvements through the Sederhana project in 1979-81 included dam construction in the main system and construction of a tertiary system. The project was implemented without local farmers' involvement. During dam construction, problems arose when water stopped flowing to the ricefields, which caused the rice crop to die. These problems were solved by the village government. After Sederhana, a juru pengairan and gatekeeper were assigned to manage the water in the main system.

The system came under the HPSIS project (SM) in 1982-83 and 1984-85 in an effort to improve irrigation management in the tertiary system. A community organizer was assigned to the system for two years. In 1982, the P3A improved its water management and maintenance in the tertiary system. To better distribute the water, a *pelompong* was used to flow the water into the fields. P3A organization and administration also improved during this period. Rp.375.000 were collected from the farmers over three harvest seasons.

After HPSIS, however, the P3A became inactive, although the P3A chairman was still there. The block system of water distribution was no longer used, and the subak system of water management returned.

At present, irrigation structures are in good condition, and the system functions at about 75 percent.

MUNCAN

The Muncan system, located in Central Lombok district, NTB, has as its water source the Muncan Dam on Aik Geuring River. Because the dam is the fifth along the river, only a small amount of water flows into the Muncan Dam area. As a result, the Muncan system receives supplement water from the High Level Diffusion (HLD), as much as 500 lps for 24 hours a week. Muncan's potential area of irrigation is 324 hectares, but only 26.5 hectares receive water from the Muncan Dam; the rest get water from other systems. The main crop in both wet and dry seasons is wetland rice, with palawija grown after the second wetland crop. Although the HPSIS project covered two villages, only Lingkung Bat can make use of the system.

Before the HPSIS project, the Muncan Dam consisted of a bamboo frame filled with rocks and soil. In 1963 and 1983, the dam was damaged and washed out by floods; in 1974, it was replaced with a gabion system built by the local subak. Costs and labor were provided by the subak. The subak controls the water, mediates conflicts among farmers, and carries out collective O&M of the main and tertiary systems, led by a pekasih.

HPSIS developed the Muncan system by constructing the main and tertiary systems, which consist of, among others, dam, intake/off-take, culverts, and side spillways. The project covered four subaks with four pekasihs. At the beginning of the project in late 1983, three COs were assigned. After physical construction was completed, the COs established P3As in two of the villages; at the same

time, six pekasihs were appointed as technical irrigation performers and an irrigation officer assigned. The irrigation officer worked for four other systems as well, and since the system functioned around the main canal, a dam watcher assigned at the dam handled O&M.

At present, only one P3A is active, although the P3A still has 3 million rupiahs from the collective rice-farming activity.

Landslides in the main canal after BCM1, Intake 1, and Intake 2, and crossed structures around the Ketak cemetery and the secondary system of BM4 limit the area that the Muncan system can serve. Although repairs have been carried out several times, every time it rains the canal collapses again. As a result, the canal remains dysfunctional, and the irrigation system has reverted to the old arrangement.

BILIKERE

The Babak and Jangkok rivers supply the Bilikere irrigation system, located in Central and West Lombok districts, NTB. Bilikere is one of two systems along the river; the larger of the two, Bilikere is located downstream from the other system. Water is rotated between the two systems, each having a turn once a week. The potential and actual area of 380.6 hectares covers three villages, whose farmers grow wetland rice in both wet and dry seasons.

The original semipermanent dam and simple intake were built by the Dutch in 1930. In 1978-79, Sederhana developed the system, constructing the main system—including a permanent dam, intake/off-take, and chutes. In 1983-84, the HPSIS project (SDM) established two P3As and developed the tertiary system.

Before 1984, pekasihs handled water distribution from the main canal to the tertiary blocks, coordinated by the kepala pekasih of the system above it. Led by the pekasih, system maintenance was carried out by the subak prior to the planting season.

Sederhana implementation was hindered by the fact that farmers asked for land compensation and no funds were available. The problem was solved by the village head. After Sederhana activities, a juru pengairan and a gatekeeper were assigned, although their responsibility was limited to the dam operation; pekasihs and the kepala pekasih were responsible for the rest of the system.

Two irrigation service officers were assigned to the system for two years to motivate farmers to actively participate in developing the tertiary system and to establish a P3A. An effort was made to train farmers to manage, maintain, and exploit the irrigation system. During the HPSIS project, the juru and gatekeeper role replaced that of kepala pekasih; now water that was previously monopolized by farmers in Central Lombok district can reach the West Lombok area.

Four years after the HPSIS project the Bilikere system was put under the EOM project, which directs that water use match crop water requirements. The juru pengairan, assisted by the gatekeeper, regulates and directs water through the intakes to match the planted area reported by each pekasih.

The system is currently functioniong, and its structures appear to be in moderately good repair. Although each village has three P3As, the direct role of the traditional subak still dominates in the tertiary blocks.

PENIMBUNG KIRI

The Penimbung Kiri system is located in Central Lombok district, NTB. Its water resources are the Penimbung Dam, second of three dams on the Meninting River, and the Pemakak Dam on Pemakak River. The Pemakak Dam was built by the Dutch government and made permanent by the local development body of Narmada subdistrict.

Potential irrigated area is 250 hectares, with the actual area being 247 hectares; the remaining three hectares are planted with coconut trees. In both wet and dry seasons, the main crop is wetland rice.

Prior to 1975, the pekasih distributed water from the dam to the tertiary system. Then the farmers themselves handled water flows to the fields. Maintenance, from the dam to the tertiary system, was done by farmers motivated and coordinated by pekasih. (Maintenance was usually carried out prior to the planting season.)

Sederhana developed the system during 1977-78, constructing a semi-permanent rock dam (replaced with a permanent dam in 1987-88), an intake, and drop and spillway structures. A juru pengairan was assigned responsibility for main system O&M, and at that point the pekasih's responsibilities became limited to the tertiary system only.

From 1982-85 the HPSIS project (SDM) worked with the system, emphasing design and construction of tertiary system and P3A formation. Construction included the tertiary and quaternary blocks and systems. Three COs were assigned to the project and formed P3As in three villages. These associations carried out water distribution at the tertiary and quaternary systems; the farmers collectively handled system maintenance and repair under P3A supervision.

After the HPSIS project terminated, however, the P3As were no longer active. The system returned to subak management once again, with water distribution by the pekasih and system maintenance by farmers collectively.

Irrigation structures remain in fair to good condition; all are functioning. The condition of main structures, such as dams, intake structures, and spillway, is about 65 percent, although all were functioning at the time of the study. About 40 percent of the quaternary system was back into wetland rice fields.

LEANG-LEANG

Located in Maros district, South Sulawesi, the Leang-Leang system takes its water from the Leang-Leang River via the Leang-Leang Dam. The potential and actual area is 572 hectares of wetland rice fields in the wet season and 40 hectares of dry-land farming (palawija) in the dry season when the river stops flowing. One village is served by the system. Before Sederhana, water management as well as maintenance and repair of the dam and structures were carried out directly by farmers, under the coordination of the village head.

The Sederhana project, implemented here in 1977-78 and 1979-80, constructed dam and other irrigation structures in the main and tertiary systems. Because the project was implemented without farmer involvement, some problems occurred: farmers did not agree with their lands being used for canals and structures and also felt that project labor should have been hired locally. The problems were eventually solved by the village government. After completion, a juru pengairan was appointed to manage the irrigation water in the main system, assisted by a gatekeeper.

From 1982 to 1985, the system was further developed by the HPSIS project (SM). During that period the P3A formed by farmers and the village government in 1980 received organizational assistance, particularly in irrigation management. A CO worked with the project for two years to help settle the remaining problems that had developed between farmers and Sederhana contractors while the tertiary system was being developed. The CO helped the P3A with organizational matters, built a P3A office, and trained farmers in water control in the tertiary system. The juru pengairan was still to manage the water in the main system.

After the HPSIS project was completed, the P3A's activities stopped—mainly because of there being no water in the dry season (thus, nothing to be managed). During the wet season, water was so

abundant that the irrigation canals turned into drainage canals instead. In 1989 and 1990, the P3A still carried out no activities. Water management was back under the coordination of the community leader, who was once the village head. By his initiative, a pump system irrigated about 100 hectares in the dry season, drawing up water that appeared in the river about a kilometer from the Leang-Leang dam. This community leader also mobilized and coordinated the farmers for maintaining the system.

At the time of the study, irrigation structures were considered in fair to good condition: about 30 percent were still good and functioning, 20 percent were slightly damaged, 49 percent were heavily damaged, and 54 percent didn't function at all.

KOCIKANG

The Kocikang system in Gowa district, South Sulawesi, takes its water from the Kocikang River via Kocikang Dam, the first and larger of two dams on the river. The dam was built by the Sederhana project in 1976. Potential and actual system area is 242 hectares, located in two villages. The farmers grow wetland rice in the wet season and no crop at all in the dry season due to lack of water.

Before 1975, Kocikang farmers irrigated with water drained from the upper wetland because there was no dam. Water flowed through the existing earth canals, which carried the drained water from the higher fields. Farmers performed maintenance work on the canals whenever asked to do so by the sub-village head.

The system was developed in 1976 and 1977 through the Sederhana project, which constructed the dam, intake structure, drop structures, and main canal. The dam was made permanent in 1981. After construction was completed, an irrigation worker was assigned responsibility for O&M and repair of the main canal.

From 1982 through 1985, the HPSIS project (SDM) was implemented in the Kocikang system, emphasizing P3A establishment and construction of the tertiary system. The project also constructed boxes and ducts in the tertiary and quaternary systems. During this period two COs were appointed (although one of them left after a year). The COs established one P3A covering two villages. Water distribution at the tertiary system was taken care of by the block chairman and the main system by the P3A.

Three months after the HPSIS project terminated, the village head changed the P3A management, replacing the association's chairman with the village secretary. Since then, the P3A has held no formal meetings. Water distribution is carried out by the block chairman, while farmers take care of water delivery to their fields.

The physical infrastructure of Kocikang is still fair to good, although the floor of the dam is badly damaged and the dam leaks somewhat.

TARETTA

The Taretta system in Bone district, South Sulawesi, takes its water from an artesian well (Waempetu) in Taretta village. A reservoir holds the water from this well, which serves only the Taretta system. Its potential area is 337 hectares, although the actual irrigated area is 192 hectares located in two villages. Farmers grow wetland rice during the wet season, but they prefer to grow tobacco in dry season because tobacco is much more valuable and there is a ready market.

During the dry season, main system O&M is generally taken care of by a *mandoro uwae;* during the wet season, however, work related to irrigation is carried out by the farmers themselves.

System infrastructure expanded with the HPSIS project in 1983-85, gaining a reservoir dam, intakes,

culverts, chutes, boxes, and animal bridges in both main and tertiary systems. During the project, the CO formed several working groups that were involved in constructing the main and tertiary canals. Each group consisted of 20-25 farmers led by a group leader. Although the groups received compensation from farmers, it was considered low. Because the farmers also were busy with their tobacco crops, the groups began to lose their members and become much less active. The CO and contractor now must find workers elsewhere, mostly from Tana Toraja.

After the project terminated in June 1985, the CO formed a P3A covering two villages. PU then assigned a juru pengairan to supervise the Taretta system and two others. The juru's heavy workload affected his handling of O&M, so in 1987 a dam watcher and a gatekeeper were assigned to help him. In practice, main system O&M was done cooperatively with the farmers, who handled the tertiary system themselves.

Two months after the completion of construction, the reservoir built by HPSIS began to leak because it was built without a foundation. The main canal, about 200 m from the reservoir before the BT2 intake, collapsed in 1987. As a result, the wetland paddy fields developed by the farmers cannot be irrigated from the system. Even the paddy fields cultivated before the HPSIS project became dry lands because the intake canal used to irrigate the system up to Tacippi village was buried and not functioning. This caused wetland rice cultivation to drop to only 62 hectares. With the community leader's support, funds were collected from the farmers to repair some of the canals and to build new tertiary canals. An additional 132 hectares of land can now be irrigated. The collapsed main canal was left untouched.

BIANGKEKE II

Located in Bantaeng district, South Sulawesi, the Biangkeke II system draws its water from Patte River through Biangkeke II Dam. This dam, the only one on the river, was built by farmers in 1969. Water discharge throughout the year is very small; although the system's potential area is 245 hectares, it actually irrigates only 22 hectares in the wet season and 15 hectares in the dry. The main wet-season crop is wetland rice, with palawija as the second crop during the dry season.

After the farmers built the dam, water and system management was carried out in a very simple way by the farmer leader and some chosen farmers. This arrangement operated until HPSIS activities began in 1984.

The Sederhana project developed the Biangkeke II system during 1979 and 1980, constructing the dam and main system. No local farmers were involved in this development. After the dam was completed, a juru pengairan, dam watcher, and gatekeeper were assigned to the system. These employees were to manage the main system, while the farmers controlled the tertiary system under the coordination of the farmer leader.

Through the HPSIS project (SDM), a community organizer was assigned to the system for two years (1984-85) to prepare and develop the tertiary system, form and strengthen the P3A, and provide guidance on O&M activities in the tertiary system—such as water-shifting. The water was shifted as follows: from December to May, irrigation water flowed mainly to the western blocks and from June to November, mainly to those in the east. Farmers began to improve their operations with high-yielding varieties, fertilizer, simultaneous planting, and pest/disease controls, undertaken in cooperation with the PPL.

When HPSIS activities terminated, the entire tertiary system had been constructed, farmers had cultivated an additional 161 hectares of wetland, and a P3A had been organized. The gatekeeper resigned in 1990, and water management—particularly distribution—fell to the P3A. The total wetland paddy blocks decreased to four, while the other six blocks were planted in kemiri and palawija due to lack of irrigation water.

At the time of the study, physical infrastructure was still fair to good: about 28 percent of the structures were heavily damaged and about 44 percent slightly damaged.

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CASE STUDIES

CUMANGGALA

Introduction

The Cumanggala Irrigation System is located in West Java, one of five provinces on Indonesia's most important and most populous island. Although this province has only 2.5 percent of Indonesia's landmass, it contains 19 percent of Indonesia's population.

Almost half of West Java's population works in agriculture. Wetland rice is the major crop for both wet and dry seasons, and is cultivated between October and January.

This site participated in both the Sederhana and High Performance Sederhana Irrigation Systems (HPSIS) projects. The Ministry of Agriculture (MOA) invested 64.4 million Rp (rupiahs) in the Cumanggala Irrigation System.

Cumanggala was chosen as a reassessment case study partly because it served as a case study for the August 1985 report evaluating the HPSIS Project (Maza 1985). Both major works and tertiary works were complete by the time of the HPSIS Project, and the site was used as an example of the transformation of a dilapidated and low-performance irrigation system into a high-performance system through use of community organizers to stimulate participation by farmers.

Currently almost two-thirds of Cumanggala's farmers are sharecroppers, and about 40 percent own between one-half and one hectare (ha) of land. Almost a third have under one-quarter ha and another third between one-quarter and one-half ha. In October 1982 small holders predominated among farmers; the average farm was about .6 ha and the total of 523 farmers was divided between 234 "share tenants" and 289 operator/leasees.

The Site

The Cumanggala Irrigation System is located in Cianjur District, West Java. The system serves three villages—Sukaraharja (upstream), Sukamaju (midstream), and Cibaregbeg (downstream).

The system receives its water from the Cijambe River, through Cumanggala Dam. The dam is the first and largest of seven along the river; in all, the system includes one major dam and 13 small supplementary dams (all but 4 of which were constructed by farmers themselves through collective or cooperative work). Supplementary water is provided from sources like the Susukan Gede Irrigation Scheme.

The actual irrigated area of the Cumanggala Irrigation System now is 191 ha in the wet season and only 40 in the dry season (although the design command is 340 ha and the potential irrigated area of the Cumanggala system is 300 ha).

Background

This irrigation system was first developed in 1910. Three farmers with large paddy fields built a simple dam of rocks and bamboo to divert water from the Cijambe River during the dry season. These farmers bought the land needed for the canal, which was about 1,500 m (meters) long and about a meter wide, located in what are now the villages of Sukamaju and Cibaregbeg. (Previously, about 500 ha of paddy fields had been irrigated by another system linked to Susukan Gede Dam.) The new

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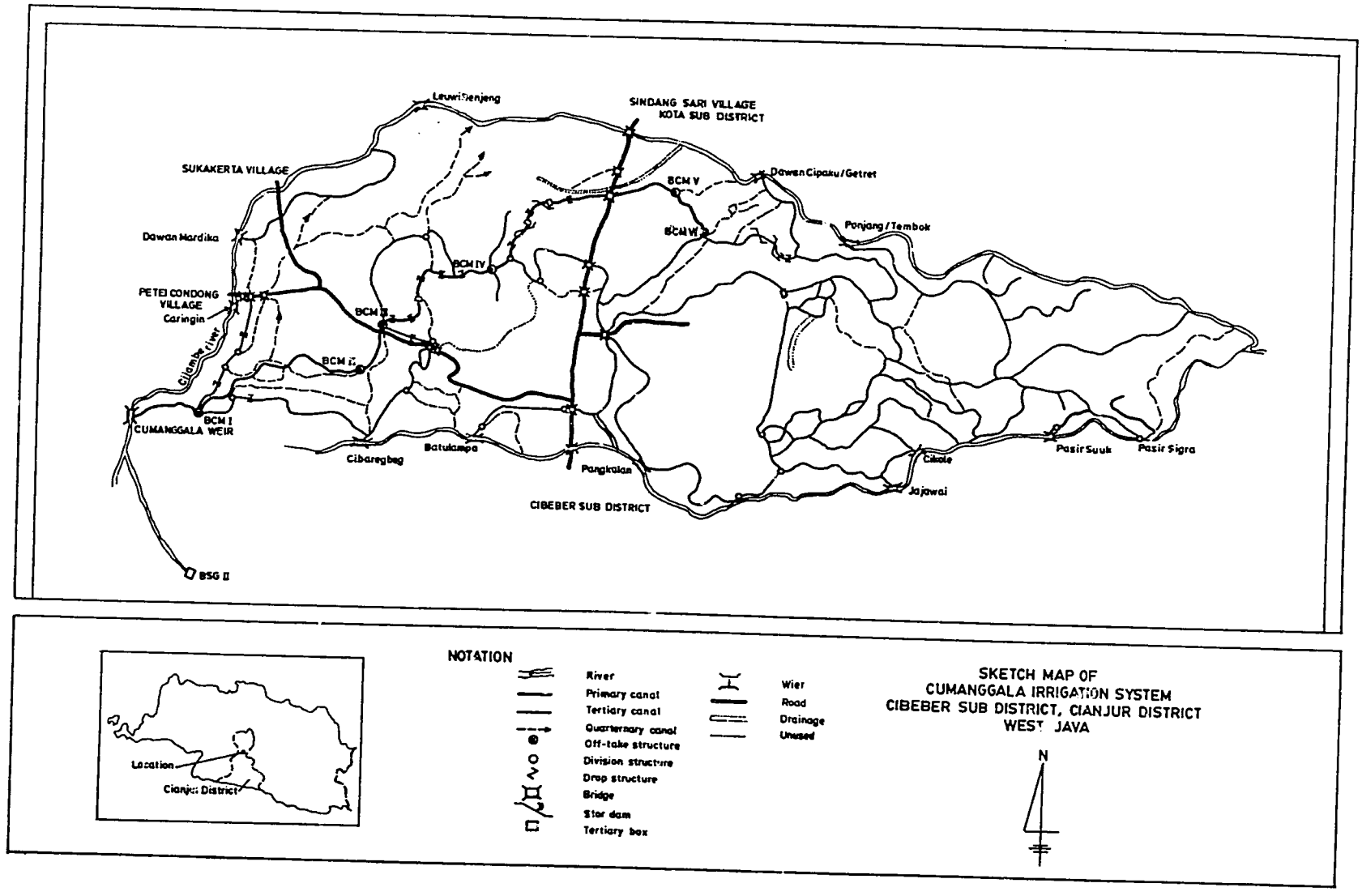


SKETCH MAP OF
CUMANGGALA IRRIGATION SYSTEM
CIBEBER SUB DISTRICT, CIANJUR DISTRICT
WEST JAVA

system washed out regularly during the rainy season. Several rich farmers, large landowners, served as informal leaders in irrigation activities, helped by the many land operators under their control.

Between 1910 and 1960, farmers gradually built additional dams in the area of these same two villages. Around the start of the Sederhana Project, the Cumanggala Irrigation System had one simple rock-piled dam; two temporary intakes of sand, soil, and bamboo; two temporary bamboo bridges; and 1,610 meters (m) of earth canal. Two wetland crops per year were possible in the upper part of the system, and one per year in the lower part. Out of an actual irrigated area of 178 ha (wet season), about 60 percent could be irrigated for paddy fields.

After the 1960s, the role of the big landowners shrank. In the 1960s, farmers in the system with no time for irrigation activities recruited one of the villagers to become the *ulu-ulu* (ditch tender or water master). This was usually an individual who had no land himself but was the son of a landowner. He was responsible for distributing water, cleaning and maintaining the main irrigation canal from the dam up to the tertiaries, and providing water to the farmers who had hired him. The ulu-ulu received payment in kind or rice from the specific farmers hiring him, use of a small piece of village land (*bengkok*), and 25 kg per ha per season from 80 percent of all the farmers.

The rest of the farmers distributed water among themselves through the tertiaries, which all farmers were expected to maintain by cooperative work. Other ulu-ulus were assigned to dams other than Cumanggala Dam, dams which provided the system with water during the dry season. Basically the irrigation system was farmer-managed, but the village agricultural officer also played a part in irrigation operation and maintenance, mobilizing farmers during a program called Bimas (Mass Guidance) in the 1960s.

Before and during the Sederhana Project, farmers took water directly by breaking the dikes of the main channels; the result was that farmers downstream could not get water. By the 1970s there were more and more conflicts among farmers over water.

The Sederhana Project

The Cumanggala Irrigation System received Sederhana Project support from 1976-78 and 1979-80. MOA invested Rp. 13.02 million in the Cumanggala Irrigation System during the Sederhana Project (1976-80) for tertiary boxes, culverts, drop structures, and chutes.

For the first time PU (Ministry of Public Works) became involved in the irrigation system. During 1976-77, PU constructed and/or rehabilitated the dam (making it permanent and lined) and main and secondary canals, encompassing a 261 ha area. Tertiary and quaternary works were constructed or upgraded between 1977 and 1978. Thus, by 1980, Cumanggala's main and tertiary systems were complete.

In 1978 two water users associations (*mitra cai*) were organized by the village leaders of Sukamaju and Sukaraharja, with the help of the agricultural extension agent (PPL). The founding meeting was attended by 100 farmers, the village head, and other village officials. Association officials were chosen; the ulu-ulu was retained, taking on the official role of association chairman, but his activities and compensation remained unchanged. He kept the keys to the intake gates in the tertiary system and cleaned the canals; PU assigned a local irrigation officer to the system too.

Although the agricultural extension agent was involved in organization of the P3As, he also organized five *wilkels*, which he used as a focus for his attention. As a result, a man serving as P3A chairman between 1978 and 1982 (later appointed ulu-ulu during the P3A reorganization in 1983) reported that P3As were inactive after their initial formation. According to his statement, farmers did not understand their responsibilities as members of an association nor were those listed as members informed of, or involved in, association activities.

The associations had no constitutions, by-laws, or records. The inactivity of the P3As reinforced the position of the ulu-ulu.

Other problems with operation and maintenance of the irrigation system were reported for that period. Maintenance was done, but poorly organized, often involving only the association chairman and the ulu-ulu, rather than collective work groups that could complete repairs to flood damage in one day. There were no rules for water allocation, and the fees from farmers were collected and used by association officers without proper accounting.

According to Maza's 1985 evaluation of HPSIS, for eight years local farmers were not free to contribute opinions or suggestions to the operation of the irrigation system; instead the association was dominated by one family. The ulu-ulu acted in accordance with the instructions of the village head who had appointed him. There was considerable inequity in water distribution.

The HPSIS Project and Results of the 1985 Evaluation

The HPSIS Project was implemented in Cumanggala from 1982-85, that is, over the full life of the project. It was a System Management (SM) site, with emphasis on technical assistance to strengthen the P3A, farmer participation in tertiary design, and the ability of PU to play its role. These goals were not completely successful—for example, system improvements in early 1984 did not involve farmers in planning, so new canals and structures were not appropriately located. Rice production, however, did increase as a result of HPSIS.

Community Organizers

In October 1982, two community organizers (COs), who lived on site with the village head, entered the system—one active in the villages of Sukaraharja and Sukamaju, the other in the village of Cibaregbeg. At the start, COs surveyed local conditions, examining irrigation infrastructure, cropping patterns, and the varieties of rice planted.

Little seemed to change in the system of water management during HPSIS, with the exception of the appearance of block ulu-ulus, who were responsible for working with farmers in the tertiaries. In October 1982, COs organized groups of farmers into five blocks (the basis for O&M working groups called *kelompok*). Block ulu-ulus were subordinate to the higher level ulus-ulus in charge of the main canals; to obtain water, a farmer now had to request it from the block ulu-ulu, who in turn had to request it from the main ulu-ulu who would open the dam gate, letting water flow into the main canal. At this point, the block ulu-ulu controlled the flow of water from the main intake to the tertiaries; the farmer would then distribute water to his field under the control of the juru pengairan, (the local PU field officer).

The existing water users associations (mitra cai) were transformed into three P3As, formed in January 1984. Under this reorganization, the existing ulu-ulu supervised one P3A, and two additional ulu-ulus were recruited to serve the other P3As. These ulu-ulus were not village officials, as were the village head and the subvillage head. One of the ulu-ulus became P3A secretary.

Because the Cumanggala Irrigation System includes several villages, the distribution of water to farms is complicated by the passage of the water supply through areas of potentially uncooperative P3As further upstream. As a result, two P3As decided to federate in 1983. Then, in 1984, the farmers of the tail section of the Cumanggala Irrigation System also organized a P3A and joined the federation, hoping thereby to gain access to more water. The new P3A was accepted into the federation because of the larger labor force its incorporation would create. The federated water users associations met every two months, and the individual associations met monthly, keeping records of activities, rosters of members, minutes of meetings, and cash books. The work groups met every two weeks.

P3A members maintained tertiary systems, coordinated by association officers. The main system was maintained by members of all the associations,

supervised by federation officers. Under HPSIS, water was distributed via rotation of blocks, implemented by three ulu-ulus and seven *andirs* (the assistants of the ulu-ulus).

Fees were set at 25 or 35 kg of unhulled rice per ha per season. Information available on fee collection for two P3As shows a discrepancy between target and collected fees, ranging from the first crop 1982-83 (Rp. 372,010 target to Rp. 188,200 collected) to that of the second crop 1983 (Rp. 312,000 target to Rp. 295,650 collected). During 1982-83 and 1983-84, while COs were still in residence, about half the farmers in each P3A contributed fees. P3As used the fees for cash, administration, irrigation system repairs and improvements, and pay for its officers. For example, in the P3A of Berkat Mufakat, 40 percent of fees went to improvements and repairs as opposed to 30 percent for pay for officers; in the P3A of Musyawarah Tani, 50 percent of fees went for pay for officers as opposed to 25 percent for improvements and repairs.

Despite having questionable long-term impact, the COs did keep busy. They visited and consulted farmers, attended P3A meetings, and conducted formal training sessions, teaching organizational skills such as proper collection of seasonal dues and recordkeeping. In addition, they participated in filming the irrigation system and collection of water management data. They spent time stimulating activities such as tree planting along the main canal, youth club events, maintenance and repair of the irrigation system, and resolution of conflicts. In December 1984, the COs made an evaluation of the CO program to date.

The community organizers left in August 1985. Within six months of the termination of HPSIS, the P3As had fallen into inactivity and the two ulu-ulus who had been newly recruited were no longer in those roles. Only the original ulu-ulu continued, filling the vacuum and again serving all the farmers of the system.

Rice Production

During HPSIS rice field areas expanded from 178 to 191 ha, drawing on formerly dry land. Before HPSIS 178 ha were irrigated during the wet season, and 133 ha during the dry season, adding up to a total effective area of 311 ha over the course of the entire year. By 1984 the total irrigated area (excluding upland and fish areas) was 344 ha and by July 1985, 368 ha. According to the P3A chairman, the increase was due to improvements in maintenance of the irrigation system and water distribution, and better planning of cropping schedules. Cropping patterns changed from rice-rice in 1982 to rice-rice-fish/upland crop in 1985.

In 1982, COs noted that 80 percent of rice varieties planted were local, with low yields and a long maturity period (5 months); the remainder were high-yield varieties. A 1985 survey by COs showed the proportion of local rice varieties planted fell from 80 to 60 percent of rice varieties planted during the wet season; also, many high-yield rice varieties were now planted during the dry season. It was not easy to persuade farmers to switch to high-yield varieties because of the demand for high-priced local aromatic rice varieties (considered to taste better). On the other hand, farmers who used high-yield varieties could have grown two rice crops plus a third upland crop or a crop of fish, resulting in increased overall income.

Yields in the head, middle, and tail areas of the irrigation system increased in both wet and dry seasons. For example, before HPSIS, the wet season rice crop in the system's tail section yielded 3.8 tons of dry grain per ha and the dry season rice crop in the tail section yielded 3.4 tons per ha; after HPSIS, the wet season crop in the tail section yielded 5.8 tons per ha and the dry season crop in the tail section yielded 4.8 tons per ha. Such increases were related not only to availability of water during the dry season, but also to more intensive application of fertilizers and pesticides and increasing use of varieties of high-yield rice. Dry season

yields were lower than those of wet season because of damage by rice field rats and because of less intensive use of fertilizer.

Infrastructure

In October 1982, the main dam was found to be leaking, with a portion washed out, and three supplementary dams were damaged (Caringin, Pangkalan, and Cijambe). In addition, 2,000 m out of 3,673 m of the main canal were silted and some 875 m of tertiary systems were nonfunctional (undercut by construction). Other sections of tertiary systems were in bad condition (4,194 m out of a total of 11,869 m); for example, 87 m of channels were so high that the water could not pass through. Parts of six canal structures, a main gate, tertiary boxes, and some chutes were broken.

Data indicate substantial upgrading of the condition of the Cumanggala Irrigation System between October 1982 and the inventory made in July 1985. By 1985, 1,210 m of farm road were in fair condition, and all dams and main or secondary canal structures were rated as being in fair or good condition (although 2,205 m of quaternary systems were considered poorly maintained). Between November 1982 and January 1985, the three water users associations cleaned and improved 121,446 m of tertiary systems and constructed an additional 1,860 m of tertiary systems, adding a tertiary box. In addition, they rehabilitated 3,535 m of main canal and eight pieces of boxes and cleaned and rehabilitated 6,635 m of main canal and seven pieces of main irrigation structures. As many as 256 farmers participated in collective work, cleaning the channels of mud and weeds and repairing the system.

The Reassessment

For many sites, the presence or absence of active water users groups has influenced system maintenance. Perhaps for that reason, there has been little long-run institutional change in Cumanggala Irrigation System.

During the five years following HPSIS, there was a change from the management of the system set up by HPSIS. The ulu-ulu expanded his responsibilities to include supervision of operation and maintenance of both main and tertiary systems, and at least two of the three P3As stopped meeting. In other words, both before and after the Sederhana and HPSIS projects, ulu-ulus were irrigation leaders, independent of PU, responsible only to the farmers hiring them and performing tasks such as clearing trash impeding the flow of water.

Although the ulu-ulu has the main role, to some extent individual farmers and PRIS (Provincial Irrigation Service) are also involved. Farmers are involved in conflict resolution and O&M of the tertiary system—water distribution, repair, and cleaning. PRIS is to supply laborers to clean the main system, and is partly involved in cropping decisions. PRIS's role is not larger because the PRIS officer assigned to Cumanggala system also supervises six other systems.

Water is in abundant supply during both the wet and dry seasons, so farmers appear to have little need to maintain the system structures. By the time of the reassessment, most of the structures in the system had deteriorated, collapsed, or were no longer functioning; the exceptions were the tertiary systems, which were in better condition and still operational. The condition of structures in Cumanggala was only rated at 61, and water potentially usable for irrigation returned to the Cijambe River.

Farmers have continued to invest in the irrigation system, albeit not at the level the government might desire. Irrigation fees increased to 35 kg per ha per season; in 1990, 75 percent of the farmers contributed at least part of their fees. Since 1985 and the end of the HPSIS Project, farmers in the system have made repairs by providing labor and a small amount of funds. Between 1987 and 1990, farmers invested Rp. .78 million and 83 man-days of labor in the system to repair the canals and Cipaku,

Pasir, and Cikole Dams. Specific repairs were reported for 1987, 1989, and 1990. The greatest participation of farmers was in 1987 when 30 farmers helped for 2 days. After HPSIS the government did not contribute to costs of repair until 1990, when MOA contributed Rp. 2 million to repair canals.

HPSIS has had a positive effect on agricultural production in the system. In the dry season (June through August), an additional 140 ha are served from other sources of water. Yield is currently 4 tons per ha during the wet season, and 3.4 tons per ha during the dry season. There is no difference in cropping patterns between upstream, midstream, and downstream sections of the system. The current pattern is rice-rice-fish/fallow, compared to a pre-HPSIS Project cropping pattern of rice-rice.

MECONGAH

Introduction

The Mecongah Irrigation System is located on the island of Lombok in the largely agricultural province of West Nusa Tenggara (NTB). Sixty-two percent of NTB's population (3,160,000 in 1987) is engaged in agriculture. The season for rice cultivation falls between December and March, and there are seven dry months during the year. Irrigation is often used to supplement available water during the rainy season. The most important food crops in NTB are wetland rice, soybeans, and cassava.

The only HPSIS sites in NTB were located on Lombok, NTB's most westward island. Lombok contains 24 percent of the entire province's land and 72 percent of its population. Lombok's population density is 166 per square km as opposed to 91 per square km for the province as a whole.

This site participated in both the Sederhana and HPSIS projects. During these projects, the Indonesian Ministry of Agriculture (MOA) invested Rp. 98.6 million in the system.

The site was chosen for this case study from the group of sites on Lombok partly because it had been used as a case study for the 1985 report evaluating the HPSIS Project (Maza 1985). At that time the site was said to have both major works and tertiary works completed. The site was described as an example of transformation of a dilapidated and low-performance irrigation system into a system of high performance, through use of community organizers to stimulate participation by farmers.

At the time of the reassessment study in the 1990s, most Mecongah system farmers were smallholders. Out of all farmers, 29 percent held under .36 ha of land, and 37 percent between .26 and .5 ha. A little more than half were sharecroppers.

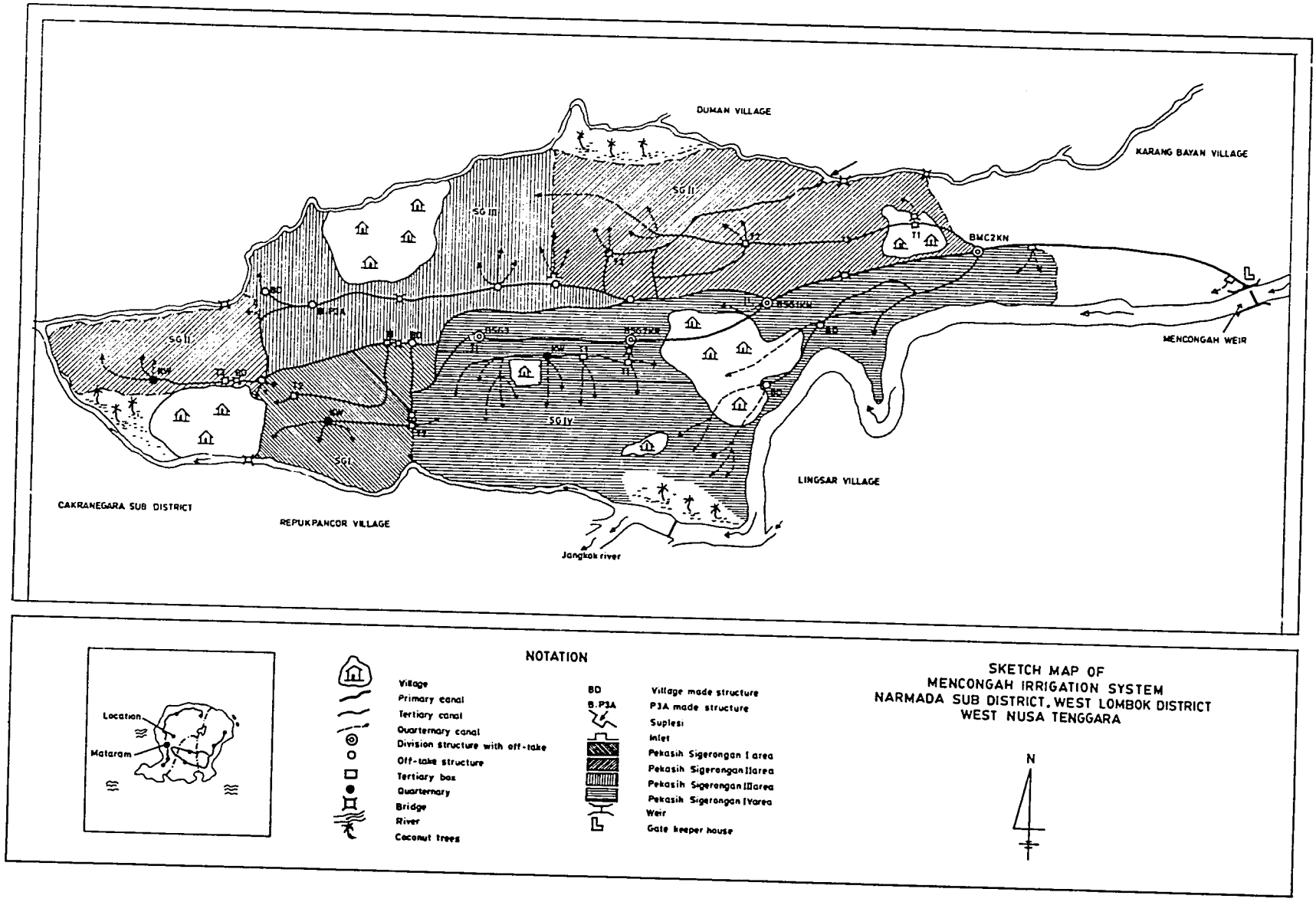
The Site

The Mecongah system is located in Narmada Sub-district, West Lombok district. The main dam, 75 m wide, is located in the upstream section of the Jangkok River. The water source for the system is the Mecongah River. Only one village, Sigerongan, is in the irrigation area, with four dams, of which the Mecongah Dam irrigates the biggest area. In 1991, the actual irrigation area of the Mecongah system is 257.6 ha out of a potential area of 301 ha.

Background

Canals existed before either the Sederhana or HPSIS projects. Of four irrigation segments within the village, three were improved in 1958 and the fourth in 1971. In 1958, one dam was made permanent with the help of villagers from two other irrigation systems. Financing came from a contribution of 100 kg of rice per ha from each farmer. In 1971 another dam was built, subsidized by accumulated irrigation fees. In 1972 landslides damaged channels, so that members from each *subak* had to take turns working each day to complete repairs.

Unwritten local rules (*awig-awig*) existed for operation and management of the irrigation system


DUMAN VILLAGE
KARANG BAYAN VILLAGE
SG II
SG III
SG IV
SG I
BMC2KN
BSG1KN
BSG3
BSG2KN
P3A
BD
KW
T1
T2
MENCONGAH WEIR
LINGSAR VILLAGE
CAKRANEGARA SUB DISTRICT
REPUKPANCOR VILLAGE
Jangkok river
Location
Mataram
NOTATION
Village
Primary canal
Tertiary canal
Quarternary canal
Division structure with off-take
Off-take structure
Tertiary box
Quarternary
Bridge
River
Coconut trees
BD
Village made structure
B.P3A
P3A made structure
Suplesi
Inlet
Pekasih Sigerongan I area
Pekasih Sigerongan II area
Pekasih Sigerongan III area
Pekasih Sigerongan IV area
Weir
Gate keeper house
SKETCH MAP OF
MENCONGAH IRRIGATION SYSTEM
NARMADA SUB DISTRICT, WEST LOMBOK DISTRICT
WEST NUSA TENGGARA
N

and could be used to resolve disputes. Water distribution in the service area was managed by four long-time informal institutions called subaks, a group of farms irrigated by a sub-unit of the irrigation system, under the leadership of *pekasihs*. These officials were appointed by the village chief. Following instructions from the village chief, they collected taxes and coordinated work groups of subak members to control water flow and maintain the irrigation system. Before 1958, pekasihs were elected by subak members and formally appointed by the *bupati* (a district chief).

The pekasih was compensated by receiving the use of a piece of land called the *pecatu*, usually about 40 ha and/or by receiving an equivalent portion of land and building taxes collected monthly, house to house. The subak collected a fee of 25 kg of dry unhusked rice per ha at harvest time.

Led by pekasihs, voluntary collective labor was mobilized every year to clean and work on canals before the planting season. Before the Sederhana and HPSIS projects, the four subaks worked together almost yearly to repair the one simple local dam when it was washed out during wet seasons.

According to information collected for the 1985 evaluation, pekasihs were not very efficient and conflicts arose between water users. Water shortages occurred downstream because of inadequate maintenance; many canals and structures were nonfunctional. Other users had more water than they needed. In the rainy season, excessive water damaged crops and caused erosion.

Before the Sederhana Project, the system had the following existing infrastructure: one semi-permanent dam (with an actual irrigated area of 167 ha); four intakes consisting of temporary divisions; and a main canal of earth, 3,000 m long. Pre-HPSIS, actual irrigated area in the Mecongah system was 211 ha.

The Sederhana Project

The Sederhana Project (1979 through 1981) upgraded the irrigation system, expanding actual irrigated area to 257 ha. It made possible an addition of a second wetland rice crop to the former single wetland rice crop and one palawija crop per year. The Ministry of Public Works (PU) constructed a dam for the main irrigation system, and new main, secondary, and tertiary canals. Existing canals were widened, extended, and straightened. Division boxes were provided. As a result of the project, system features became permanent—one dam, 5 intakes, 18 drop structures, a spillway, a bridge, and 4 culverts. The main canal was no longer completely earthen—1,020 m had been lined. The tertiary system now included 3,306 m of earth canals.

The project, however, was implemented without involving local farmers. Farmers refused to offer right-of-way. Construction plans were not announced, so the local rice crop died during construction of the dam, when water flowing to rice fields was stopped. Builders also antagonized farmers by taking surface soil and grass from fields for canal embankments. Other problems included a discrepancy between tertiary boxes and actual field conditions, and the size of new canals. New canals were too small and overflowed during heavy rains and irrigation.

As part of the project, a water users association (P3A) was formed, but it was subsequently inactive. This association posed a conflict of interest with existing officers of the subaks and with the pekasihs. Pekasihs continued to mobilize collective work for maintenance and repair of canals. After the Sederhana Project ended, PU assigned a *juru pengairan* (local irrigation officer) and a gatekeeper to manage water in the main irrigation system, for example, by opening dam gates.

The HPSIS Project and Results of the 1985 Evaluation

The Mecongah system was an HPSIS System Management (SM) site. Under the project, during 1982-83 and 1984-85, the focus at Mecongah was on institutional development, given the full development of the main and tertiary systems.

During the project, nonetheless, the system did acquire 12 permanent measuring devices, and the actual irrigated area expanded to 260 ha.

HPSIS planned that P3A members would take care of the flow of water to the rice fields, maintain the infrastructure, use collective work groups when needed, and contribute membership fees to the association. It is not clear if all these HPSIS goals have been met since the end of the project.

HPSIS had an immediate impact. The 1985 site evaluation concluded that farmer participation, cropping, and interagency coordination had all been improved. A lot for a P3A office was bought with government money, and an office was built with voluntary labor. After the Sederhana Project, the system leaders, water distribution, maintenance, and repairs did not change; after HPSIS, however, water distribution was regulated and alternated according to the size of fields, and maintenance occurred before each planting season.

Community Organizers

The agents for institutional development were community organizers (COs). Two were assigned to the system from August 1982 through December 1985. The COs met with influential villagers and village authorities, then more importantly, with each pekasih and subak member, and eventually with all system users. At the meeting with all system users, P3A leaders were chosen, including a former pekasih as P3A chairman. At that meeting each farmer's contribution for services and salaries was set; it was to be 25 kg of unhulled rice per ha in three blocks and 50 kg in the fourth, the tail section, where more maintenance and distribution work was demanded of the *pekasih*. In total, the COs held 29 meetings to discuss problems and organizational development, and provided a number of formal training sessions.

Under the COs the P3A was reorganized. A P3A had been formed in 1981 by the agricultural extension agent, but remained dormant until September 1983. During reorganization, the irrigation system was divided into four blocks and a roster of members made. These blocks varied in size, depending on service area. A person was appointed to allocate irrigation water. Farmer participation was high: the 1985 evaluation reported that all farmers participated in canal repair, canal maintenance, and road improvement, and about two-thirds of the farmers participated in upgrading and maintaining canal structures.

COs were said to integrate the subaks into the P3A, by the substitution of divisions or blocks for subaks. Even after the 1983 reorganization of the P3A, however, pekasihs continued to serve subak members in three out of four blocks (suggesting the need to investigate the long-term impact of HPSIS). In the fourth block, water distribution became the task of the staff of PRIS and the head of the blocks. Thus, in most cases, the pekasih made decisions about water distribution and O&M (except in block Sigerongan IV).

Fee collection was regularized—fees collected by pekasihs were handed over to the P3A chairman and deposited in the bank by the chairman and the association treasurer. The fees were allotted to improvements in irrigation and to O&M; one-quarter of all fees went to LKMD, the Institute of Village Community Relations. During the three harvest seasons immediately following the P3A's revival, Rp. 375,000 was collected from farmers; these funds were used to repair a broken tertiary system box and to purchase land for the P3A office and for two small meeting houses.

Infrastructure

Upon arrival, COs had found 1,193 m of main and secondary canals in poor condition, and all 5,732 m of tertiary and quaternary systems poorly maintained. Of 26 main canal structures, 3 were found to be in poor condition.

As a result of HPSIS intervention, Mecongah Irrigation System was repaired and expanded—200 m of main canal and 200 m of tertiary systems were built, and 2,707 m of main and secondary canals were upgraded. Sixteen pieces of tertiary structures

were repaired, and 11 pieces of illegal turnouts were removed. Seven drop structures were gated, and 2,702 m of main and secondary canals were cleaned of plants and garbage and maintained.

Rice Production

COs were expected to provide technical assistance and agricultural intervention (with the help of the extension agent), as well as help with organizational development and system-building. In 1982 the COs conducted a local survey. Actual irrigated area was 249 ha during rainy seasons, and 240 ha for other crops. Crops were rice, but the district head (the bupati) was subsequently able to enforce uniform cropping changes (back to rice-rice-palawija) by threatening uprooting of crops of those resisting.

Between 1981 and 1983, rice cultivation in the Mecongah irrigation area changed. Instead of local varieties, with maturity rates from five to six months, farmers planted high-yield varieties such as VUTW or IR 36, with shorter periods of maturity. Production increased from an estimated 500 bundles (each 6 kg) per ha to 5.5 tons per ha.

Upland crops were not planted during irrigation system construction. When resumed, cropping became two successive rice crops, and then a dry season crop, palawija or upland crops (especially soybeans). Changes in cropping created seed and labor shortages. Although the labor shortage caused labor costs to increase, it also eased unemployment. Positive results of cropping changes were resumption of leguminous crops in place of commercial fertilizers and facilitation of water distribution thanks to uniform crop growth.

The Reassessment

HPSIS had little long-term institutional impact at the site. After the project ended, the P3A again became inactive, and the block system instituted during the project was no longer used. The subak system was revived, although the role of P3A chairman continued to exist. Both before and after the projects, there were 4 pekasihs. Currently, each leads a subak.

Subaks and pekasihs are responsible for the tertiary system and are expected to resolve irrigation system conflicts (for example, if a farmer's ducks eat a neighbor's newly planted seeds). Often in possession of water gate keys and in charge of opening and closing gates, pekasihs oversee tertiary water distribution, and they and/or individual farmers are responsible for repairing and cleaning the tertiary system. The Provincial Irrigation System (PRIS) takes responsibility for the main irrigation system. The PRIS officer is responsible for distribution of water through the main system, and for its repair. PRIS laborers are responsible for cleaning the main system. Decisions on cropping patterns (which can determine water needs) lie with either the PRIS officer or the agricultural extension agent.

Farmers seem to continue to invest in main and tertiary systems, despite government policy that they are only responsible for O&M of the tertiary system. Currently, fees are collected through subaks and pekasihs, although in one subak farmers stopped paying the P3A chairman in 1984 when they felt he had misused subak funds.

Infrastructural changes since HPSIS include an increase from one to five permanent bridges (of which three are for animals) and an increase in the length of lined main canals to 1,908 m, reducing the number of meters of earth canals.

At present, structures in Mecongah are in good condition, with an overall average of 80 percent of them functional. In 1986 and 1989, repairs to the main canal and some culverts were made, using labor (101 man-days) and materials contributed by farmers. In 1987, two subaks had to cooperate to fix a break box (water gates) and provide members to collect rocks. In 1990, repair of the main canal and several culverts was made, using government contributions of labor (81 man-days) and material (13 bags of cement and 2 m^3 of sand).

HPSIS and Sederhana Projects have had a positive impact on agricultural production in the system. After HPSIS, rice yields were 4.2 tons per ha in wet season and 3.3 tons per ha in dry season; before HPSIS, rice yields were estimated at 2.9 tons per ha. Actual irrigated area is 257 ha during wet season and 257 ha during dry season, compared to 211 ha pre-HPSIS and to a potential irrigated area of 301 ha. The cropping pattern is currently rice-rice-palawija. At present, upstream, midstream, and downstream sections of the system follow the same cropping patterns and schedules.

KOCIKANG

Introduction

The Kocikang Irrigation System is located in the province of South Sulawesi, the main population and communication center of eastern Indonesia. Sixty percent of the province's total population works in agriculture. The most important food crops are wetland rice, soybeans, and cassava.

This site participated in both the Sederhana and HPSIS projects. Over the course of the two projects, the Indonesian Ministry of Agriculture (MOA) invested Rp. 35.6 million in this system.

The site was chosen as a reassessment case study as an example of the System Development and Management (SDM) model used at some HPSIS sites. (The two other sites studied—Mecongah and Cumanggala—are examples of the System Management model.) The level of infrastructural development changed in the course of HPSIS. The site was also chosen because of the differences between pre-HPSIS irrigation management at Mecongah, Cumanggala, and Kocikang.

The Site

The Kocikang Irrigation System is located in two villages in Sungguminasa-Gowa district, Kocikang and Pattallasang. Water comes from the Kocikang River, and flows through the Kocikang Dam. A *bronjong* (barbed wire) dam was built by the Sederhana Project in 1976.

The Kocikang River is rain-fed; due to uneven distribution of rainfall throughout the year, the river is dry during the dry season. Although rainfall varies widely from year to year (in the province in general and in Kocikang in particular), total yearly rainfall is high compared to West Java and NTB. Average monthly rainfall at 225 mm per month is rated as sufficient.

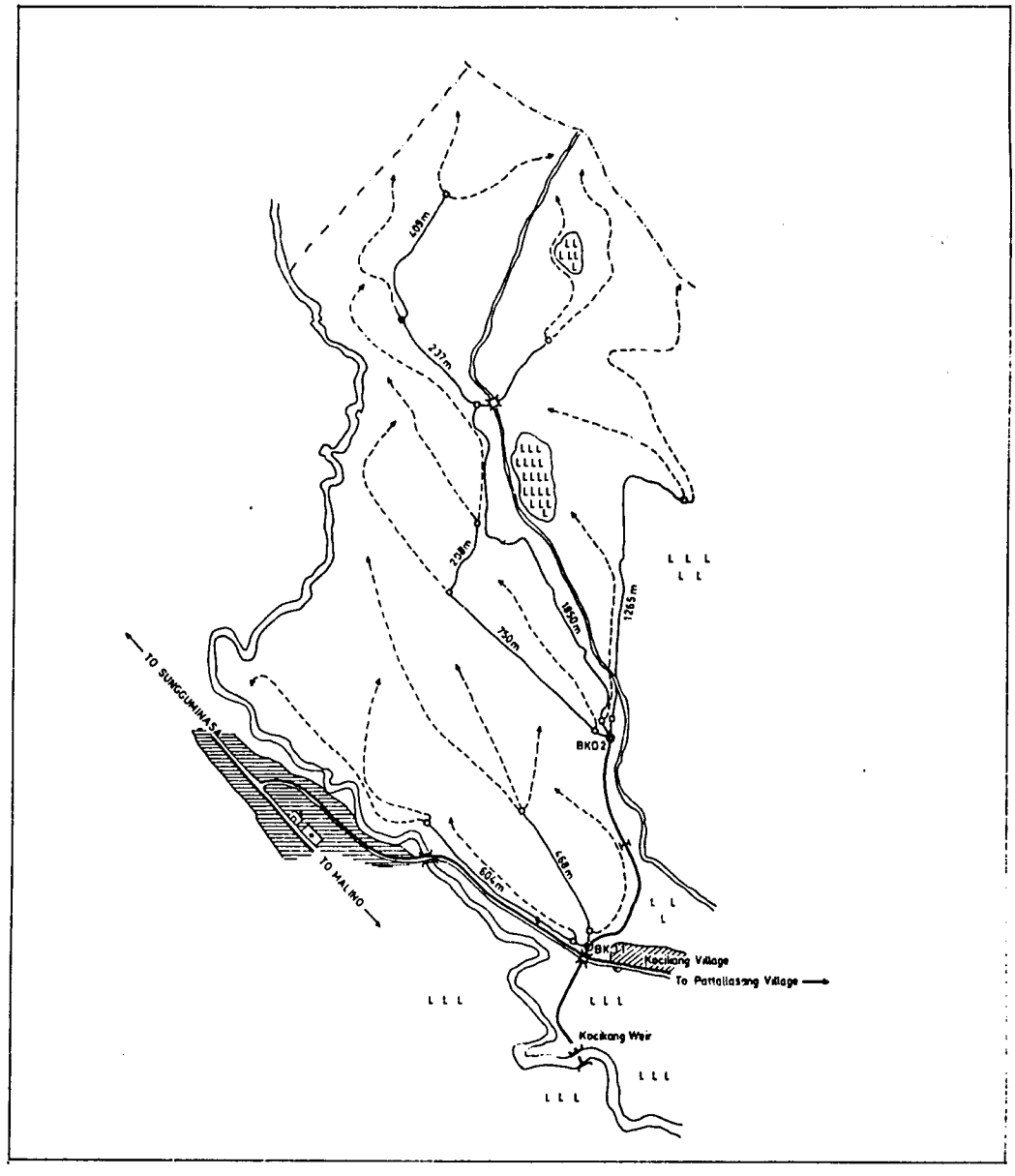
Potential and actual irrigated area are 242 ha. Farmers grow only one crop, wetland rice, because there is insufficient water for crops in the two-month dry season.

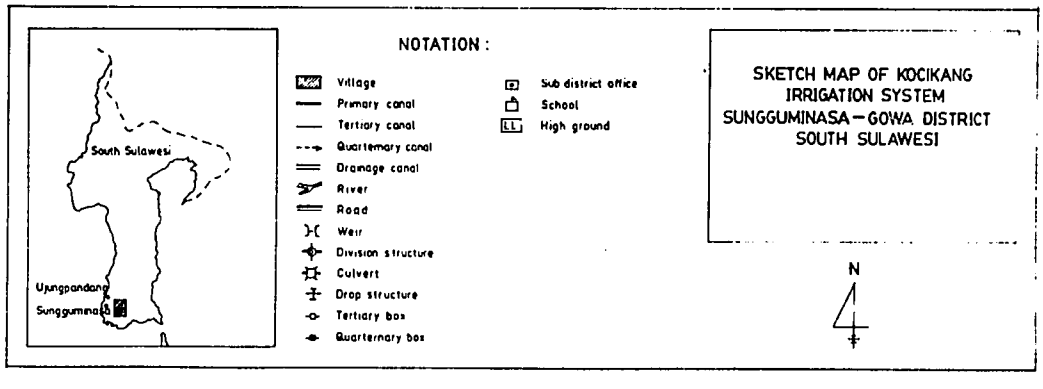
Currently, over half the farmers are owners. About half work holdings between .26 and .5 ha; another quarter have holdings under .26 ha, leaving a little under a quarter of all farmers with holdings between .5 and 1 ha.

Background

Before the Sederhana Project, farmers received water through a free intake from the Kocikang River and through rainfall. There were no dams in the system—just a syphon of simple material. Irrigation water was drained from the upper wetland and distributed through existing earth canals, leading the water from higher fields to lower ones. At the request of the sub-village head, farmers maintained these canals.

In South Sulawesi, there were no traditional irrigation associations. The pre-HPSIS local irrigation official was called the *pinati* (village elder), and there was at least one for each of the 3 sub-villages (Pakkato with one pinati for 40 ha; Kocikang with one pinati for 82 ha; and Borong Pallala with three pinati for 120 ha). The pinati's duties included determining timing for soil preparation, planting, and harvesting. He led the ceremony of plant preparation called *Apasulupajeko*. In the past the pinati benefitted from *panganrean* (village-owned land), which no longer exists.


409m
237m
238m
750m
1850m
1265m
TO SUNGGUMINASA
TO MALINO
BKO2
BKO1
Kocikang Village
To Pattallassang Village
Kocikang Weir


South Sulawesi
Ujungpandang
Sungguminasa
NOTATION :
Village
Primary canal
Tertiary canal
Quartemary canal
Dramage canal
River
Road
Weir
Division structure
Culvert
Drop structure
Tertiary box
Quarternary box
Sub district office
School
High ground
SKETCH MAP OF KOCIKANG
IRRIGATION SYSTEM
SUNGGUMINASA – GOWA DISTRICT
SOUTH SULAWESI
N

Sederhana Project

In 1976-77, the project developed the Kocikang Irrigation System by constructing the *bronjong* dam and a series of other permanent structures for intake (2), drop (1), spillway (1), culvert (1), and syphon (1—metal). As a result of the project, the main canal, built of earth, was 1,164 m long. Farmers continued to be free to take water; there was no gate in the main intake structure of the system, nor were any distribution regulations established. The Sederhana Project did not reorganize existing arrangements for irrigation.

HPSIS Project

During the HPSIS Project, 1982-85, the System Development and Management model was implemented in Kocikang. Emphasis was placed on establishing a water users association (P3A) for the two villages and on developing an "official" tertiary system. The agent to accomplish these goals was the community organizer (CO), and P3A formation was closely linked to training programs for farmers.

Community Organizers

As part of HPSIS, two COs were appointed for this system, but by the end of the project only one remained. Contrary to usual HPSIS practice, the CO did not live in the village, but rather lived 23 km away in Ujung Pandang; during the rainy season, however, he stayed in the village 3 to 4 days a week.

COs began working in the area in August 1982, and the one remaining CO left in December 1985. The COs called meetings attended by members of the village government and all the farmers. During such meetings, they made presentations to the village head, key farmers, and others, teaching them to run organizations, specifically the water users association. For example, the secretary was taught a filing system and to keep the guest book, the treasurer bookkeeping, and the chairman to lead a meeting. The P3A set up a list of members, a guest book, a map of the irrigation network, and an inventory of land ownership. Between 1982 and 1986, officers of the P3A received training of 4 to 7 days on water management, water distribution, and crop production. The P3A chairman and secretary usually attended, often accompanied by other village or association officials.

A P3A was started in April 1983, and officers chosen for 1983-85 included the leader of the farmers as chairman and the sub-village head of Kocikang as treasurer. One task of the P3A was to discuss system design, and another to settle land acquisition issues, for which there was no compensation.

An innovation of the HPSIS Project was organization of the service area and farmers into blocks. The block chairman was given responsibility for the tertiary system. During the HPSIS Project, system-level PRIS (Provincial Irrigation Service) staff oversaw the main system, but the head of a block managed water distribution to the tertiary system, at which point farmers took over distribution. In case of disputes, the head of the sub-village (*kepala kampung*) took responsibility for conflict resolution. The sub-village head was also the one to encourage operation and maintenance (O&M) work involving repair and cleaning of main canals and tertiary systems, prior to planting.

Pinatis were not involved in project implementation. Farmers (as members of the P3A) were involved in surveying, construction, and providing input about design. Before each planting season, the CO conducted meetings to discuss maintenance of the irrigation network, as proposed by the village head. In cooperation with the extension agent, another activity of the COs was agricultural intervention and technical assistance with farm management, cropping patterns, and new varieties of rice.

Infrastructure

HPSIS activities focussed on construction and management. Additions were made to the system during the community organization period. Among the COs' most impressive accomplishments were

4,909 m of tertiary earth systems designed and constructed with farmer participation. Other accomplishments included 16,563 m of quaternary systems, 7 tertiary boxes and 7 quaternary boxes, 1 duct, 2 *avur* [sic] to drainage channel and 14,615 m of drainage channels. Although farmers were free to take water as they wished from the tertiary system, a gate was added to the intake system, alternating water use.

During the rainy season farmers distributed water themselves; if water was available and rice fields had not been irrigated, a farmer could request a gatekeeper to open it—at that point the farmer himself would direct the water to his field. Usually the village head would request the farmers to conduct system maintenance, under the leadership of the P3A chairman.

The Reassessment

It is not clear that all is going according to HPSIS plans to improve infrastructure, water management, and farmer participation. Unlike the sites of Mecongah or Cumanggala, the irrigated area in the Kocikang system has remained constant at 242 ha, before, during, and after the Sederhana and HPSIS projects. There has been no change in cropping patterns, which remain rice-fallow. After HPSIS, pinati activities did not change, but only 10 percent of farmers remained loyal to the pinatis. The rest turned to what is called the "applied modern farming system" (i.e., abandoning the traditional ceremony for preparation of the soil), despite the fact that each pinati had held his post for at least six years.

Before the Sederhana and HPSIS projects, the pinati was the irrigation leader; currently, the pinati carries out no collective duties. As village elder, he has input, along with the extension agent and PRIS officer, in decisions about cropping patterns. It is the PRIS officer and village head, however, who must resolve conflicts. The gatekeeper (*penjaga pintu air*) distributes water from the main system, while the block chairman distributes block water and farmers (individually or in groups) arrange water delivery to their fields.

At other sites in the province of South Sulawesi there has been a shift to informal leaders and village government officers. Similarly, six months after HPSIS ended, the village head replaced the HPSIS-era P3A chairman with the village secretary, who became the irrigation leader at Kocikang. Subsequently, the P3A did not hold formal meetings. Current P3A officers have held their positions for at least five years. The P3A chairman is still the village secretary, and the association secretary is the dam guard.

The influence of the village head is evident in decision-making related to the irrigation system, said to be in the hands of farmers or the village head. As individuals or part of a group (*kelompok tani*), the farmers decide about water distribution and irrigation operations, and the village head decides about maintenance and repair of damage to structures and canals. When deemed necessary, the task of cleaning canals is proposed by the village head, and the village head and P3A chairman implement the work to repair canals and the dam floor.

In September 1990 PU (Ministry of Public Works) recreated the P3A to collect IPEP (a water service fee exclusively found in South Sulawesi province). The P3A has 15 blocks, each of which has 20 farmers and covers 15 hectares. At the time of the reassessment, it was too soon to evaluate the effectiveness of this change. In addition to IPEP, as of 1990 each farmer was to contribute 25 kg per ha to the P3A and 1 to 5 kg to the pinati. However, as an example of the falling rate of contribution to the pinati, in one sub-village, only 10 percent of farmers actually paid their share.

Through PRIS, PU does construction. The farmers contribute labor to maintain and operate the tertiary systems, and assisted by farmers, PU maintains the main canal, with cleaning done by PRIS laborers.

Farmers contributed labor to canal repair in 1985-86 and 1989-90. For example, in 1989, a meeting was held and a decision made to repair the main canal; as a result, 30 farmers participated in making

repairs. The government contributed no money to this effort; farmers contributed labor. The government did contribute to the repair of the dam floor in 1988.

Physical infrastructure of the Kocikang system consists of the same elements as during the years of the HPSIS project, with 16,563 m of quaternary earth canals and 4,615 m of earth drainage canals. At the time of data collection, the physical infrastructure of the system was in fair to good condition. There were, however, some leaks in the dam, and the floor of the dam was badly damaged. This deterioration has occurred at a faster rate than predicted, because O&M is done only once a year (given that only one crop is produced per year).

After HPSIS, rice yields were 3.4 tons per ha in wet season, a substantial increase over pre-HPSIS rice yields of 2 tons. Cropping patterns pre- and post-HPSIS did not change, nor are there any differences in the Kocikang system between upstream, midstream, and downstream cropping.

F

PHYSICAL INFRASTRUCTURE

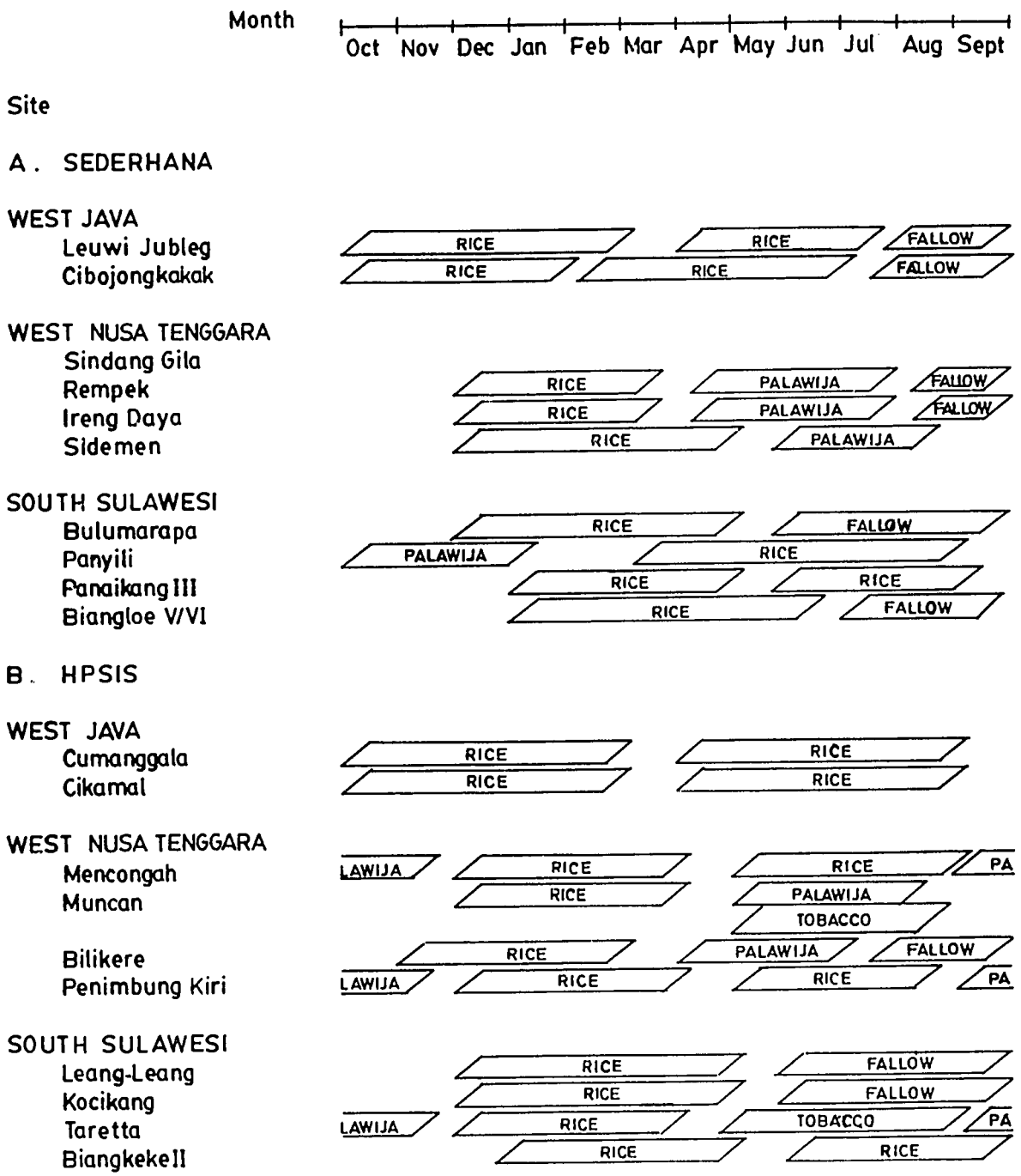
Assessment of the Structures in the Study Sites

Site	Structure						Canal			Average
	Dam/	Div/off-weir	Drop take	Cul-str.	Spill vert	Chute way	Prim/	Tert/Sec.	Drain Quart.	
					(%)					
Sederhana										
West Java										
Leuwi Jubleg	75	50	60	75	75	-	75	50		65
Cibojongkakak	80	60	70	80	80	-	75	-		75
West Nusa Tenggara										
Rempek	80	85	50	90	-	50	90	80		75
Sidemen	90	90	80	90	90	80	80	80		84
Sindang Gila	90	90	80	90	-	80	90	90		88
Ireng Daya	75	80	80	70	-	-	75	70		75
South Sulawesi										
Bulumarapa	80	80	60	75	70	60	70	70		70
Panyili	80	70	-	-	-	-	70	50		67
Biangloe V/VI	85	60	75	-	90	85	-	-		80
Panaikang III	85	85	85	80	-	80	80	-		82
HPSIS										
West Java										
Cumanggala	80	70	50	-	-	50	70	50	60	61
Cikamal	90	75	60	-	-	70	80	80	-	75
West Nusa Tenggara										
Mencongah	90	80	80	80	80	-	60	90	80	80
Penimbung Kiri	90	-	60	80	-	80	90	80	-	80
Muncan	70	70	-	75	75	75	50	50	-	67
Bilikere	85	80	80	-	-	-	80	80	60	78
South Sulawesi										
Leang-Leang	85	50	60	50	-	-	60	60	-	60
Kocikang	80	70	60	60	60	60	70	60	-	65
Taretta	80	60	-	80	80	-	50	50	-	65
Biangkeke II	90	80	60	90	50	60	75	50	-	70

G

AGRICULTURE

IRRIGATED CROPPING PATTERN IN STUDY SITES BEFORE PROJECT IMPLEMENTATION



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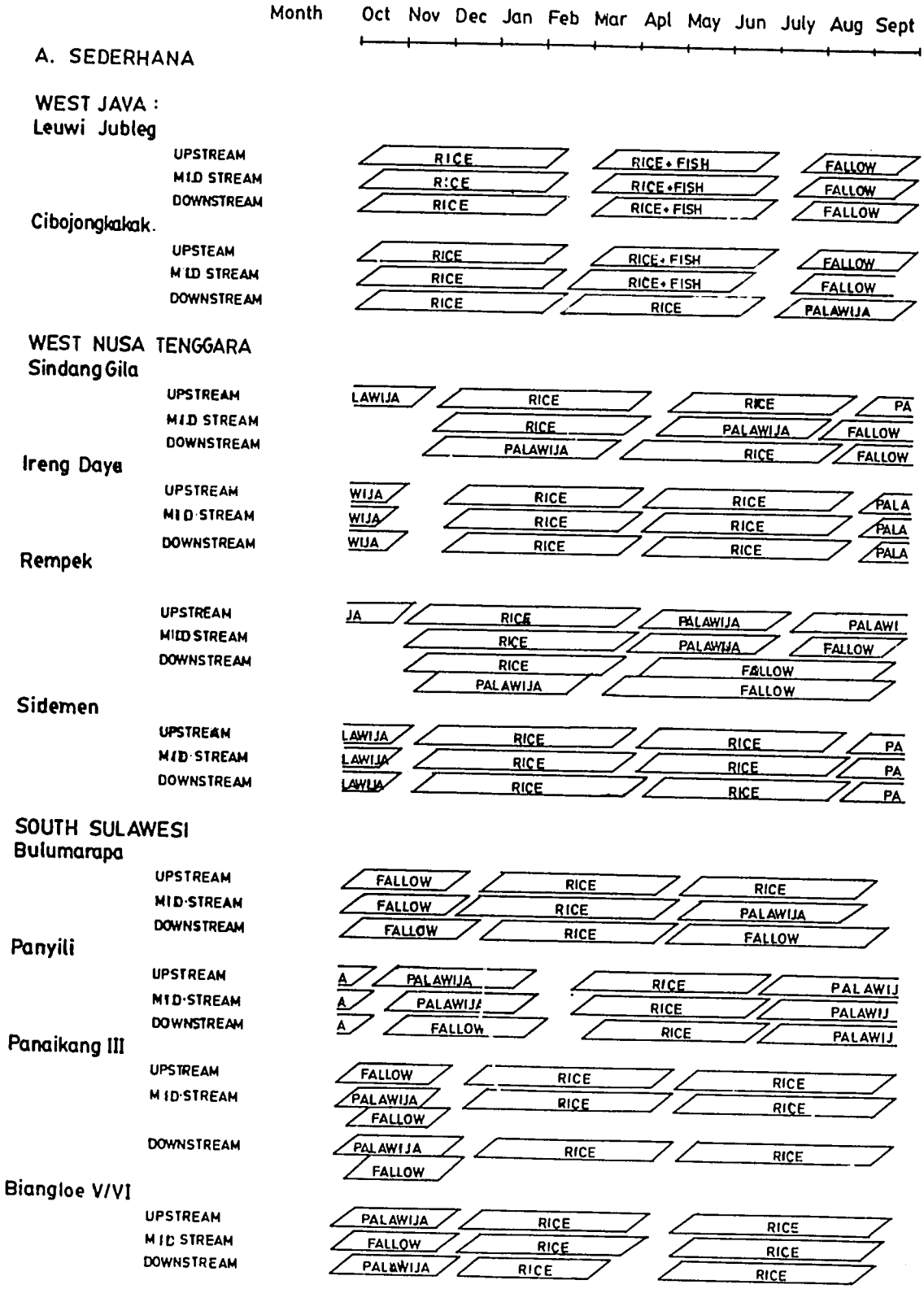
IRRIGATED CROPPING PATTERNS IN STUDY SITES AT PRESENT



Month Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sept

B. HPSIS

WEST JAVA

Cumanggala

UPSTREAM: RICE | RICE | FALLOW
MID-STREAM: RICE | RICE | FALLOW
DOWNSTREAM: RICE | RICE | FALLOW

Cikamal

UPSTREAM: RICE | FISH | RICE | FALLOW
MID-STREAM: RICE | FISH | RICE | FALLOW
DOWNSTREAM: RICE | FISH | RICE | FALLOW

WEST NUSA TENGGARA

Mencongah

UPSTREAM: LAWIJA | RICE | RICE | PA
MIDSTREAM: LAWIJA | RICE | RICE | PA
DOWNSTREAM: LAWIJA | RICE | RICE | PA

Muncan

UPSTREAM: WIJA | RICE | RICE | PALA
CO | TOBAC
MIDSTREAM: THE IRRIGATION SCHEME DO NOT IN FUNCTION
DOWNSTREAM: THE IRRIGATION SCHEME DO NOT IN FUNCTION

Billikere

UPSTREAM: LAWIJA | RICE | RICE | PA
MIDSTREAM: LAWIJA | RICE | RICE | PA
DOWNSTREAM: LAWIJA | RICE | RICE | PA

Penimbung Kiri

UPSTREAM: LAWIJA | RICE | RICE | PA
MIDSTREAM: LAWIJA | RICE | RICE | PA
DOWNSTREAM: LAWIJA | RICE | RICE | PA

SOUTH SULAWESI

Leang-Leang

UPSTREAM: RICE | PALAWIJA | FALLOW
MIDSTREAM: RICE | RICE* | FALLOW
DOWNSTREAM: RICE | FALLOW
WATER PUMP IRRIGATION

Kocikang

UPSTREAM: RICE | FALLOW
MIDSTREAM: RICE | FALLOW
DOWNSTEAM: RICE | FALLOW

Taretta

UPSTREAM: PALAWIJA | RICE | TOBACCO
MIDSTREAM: RICE | PALAWIJA | TOBACCO
DOWNSTREAM: CE | PALAWIJA | PALAWIJA | RI

Biangkeke II

a. WESTERN

UPSTREAM: LOW | RICE | PALAWIJA | FAL
MIDSTREAM: LOW | RICE | PALAWIJA | FAL
DOWNSTREAM: PALAWIJA | PALAWIJA | FALLOW

b. EASTERN

UPSTREAM: FALLOW | PALAWIJA | RICE
MIDSTREAM: FALLOW | PALAWIJA | RICE
DOWNSTREAM: PALAWIJA | PALAWIJA | FALLOW