THE SEDERHANA ASSESSMENT STUDY FOR WEST JAVA, WEST SUMATRA, NORTH SUMATRA AND SOUTH SULAWESI PROVINCES, INDONESIA

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Studi Penilaian Proyek Irigasi Sederhana Untuk Propinsi Jawa Barat, Sumatra Barat, Sumatra Utara dan Sulawesi Selatan

oleh

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Antara Januari 1984 dan Maret 1985, P.T. EXSA mengadakan survei dan analisa untuk lebih dari 1600 contoh (sample) proyek Sederhana di Indonesia, termasuk proyek pengairan skala kecil (kurang dari 2000 hektar) yang telah dibangun dan/atau direhabilitasi oleh pemerintah Indonesia.

Contoh ini mencakup 30 dari 885 proyek serupa yang telah menerima bantuan USAID. Proyek-proyek tersebut, yang telah berjalan selama sekurang-kurangnya dua tahun, berlokasi di Jawa Barat, Sumatra Utara dan Barat, dan Sulawesi Selatan. Proyek-proyek ini telah disurvei untuk menentukan dampaknya pada daerah-daerah yang telah memperoleh pengairan, kwalitas pekerjaannya, dan kemampuan pelaksanaannya. Survei ini dimaksudkan untuk digunakan dalam mengembangkan metode-metode "cost-effective" untuk perencanaan proyek-proyek pengairan skala kecil yang baru dan untuk memonitor pelaksanaan proyek-proyek yang ada.

Kegiatan ini dilaksanakan dalam empat tahap. Pertama, memilih lokasi penelitian dan mengumpulkan data-data tambahan dari pihak pemerintah Indonesia dan USAID. Kedua, mengadakan penelitian di lapangan dan mengumpulkan data-data sosial-ekonomi dan pertanian. Ketiga, memetakan jaringan-jaringan pengairan, pemanfaatan lahan dan daerah yang telah diberi pengairan. Terakhir, mempersiapkan, memeriksa, dan memperbaiki laporan-laporan.

Index utama dari kemampuan pelaksanaan dalam penilaian ini adalah hubungan antara daerah yang sungguh-sungguh telah diberi pengairan (AIA) dalam musim hujan (WS) dan daerah yang direncanakan untuk diberi pengairan (DIA), atau persentase dari AIA/DIA(WS). Index AIA/DIA ini dipandang dari segi kondisinya yang sekarang dan dari segi besarnya perubahan yang terjadi sebelum dan sesudah adanya proyek tersebut.

Untuk 26 buah proyek yang didapatkan berjalan baik, hasil survei menunjukkan bahwa 86% dari bangunan-bangunan dan 80% dari kanal dalam keadaan baik; proyek mengairi 72% dan 142% dari DIA dalam musim hujan dan kering; dan hasil panen padi rata-rata 4218 kg/ha dalam musim hujan dan 3907 kg/ha dalam musim kering. Demikian juga, perubahan AIA/DIA dari sebelum hingga sesudah adanya proyek adalah sebesar 16% dalam musim hujan dan 43% dalam musim kering, dan setelah jangka waktu rata-rata 4 tahun, peningkatan hasil panen dari sebelum hingga sesudah adanya proyek adalah 26% dalam musim hujan dan 17% dalam musim kering.

Berdasarkan pada standar persentase untuk perbandingan pelaksanaan proyek, kira-kira setengahnya digolongkan sebagai proyek yang baik sekali sampai baik, dan setengah yang lainnya sebagai proyek yang sedang serta proyek yang kurang baik. Masalah-masalah utama yang ditemukan adalah sebagai berikut: kondisi bangunan-bangunan atau sistim penyediaan air yang kurang baik, pemilihan tempat yang kurang menguntungkan dari segi sistim penanaman dan pilihan para petani, pengairan di daerah-daerah DIA yang ternyata sudah mendapat pengairan dengan baik sebelum adanya proyek, ketergantungan yang berlebihan pada rehabilitasi sistim bangunan yang ada daripada membuat percabangan baru dan sistim baru penyampaian air untuk melayani daerah-daerah baru, dan terlalu besarnya daerah DIA bagi sistim tersebut atau bagi air yang tersedia.

EXECUTIVE SUMMARY

Between January 1984 and March 1985, P.T. EXSA International Co. Ltd. surveyed and analyzed a sample of the over 1800 "Sederhana Projects" in Indonesia. These are small-scale (less than 2000 hectare) irrigation projects that have been constructed and/or rehabilitated by the Government of Indonesia (GOI).

The sample consisted of 30 of the 885 such projects that have received support from USAID. The projects, which had been in operation for at least two years, were located in West Java, North and West Sumatra, and South Sulawesi. They were surveyed to determine their impact on irrigated areas, the condition of their works, and their performance. The surveys were intended for use in developing cost-effective methods for planning new small-scale irrigation projects and in monitoring the performance of existing projects.

The work was conducted in four phases. First, survey locations were selected and secondary data were collected from the GOI and USAID. Second, field surveys were conducted and socio-economic and agricultural data were collected. Third, irrigation networks, land use and irrigated land were mapped. Last, the reports were prepared, checked and corrected.

The primary index for performance in this assessment was the relationship between the actual irrigated area (AIA) in the wet season (WS) and the design irrigated area (DIA), or the percentage AIA/DIA (WS). These AIA/DIA indicators were considered both in terms of their present state and in terms of the amount of change before and after the project.

For the 26 projects found to be operational, the survey results show that 86 percent of the physical structures and 80 percent of the canals are in good condition; the projects irrigate 72 percent and 142 percent

of their DIA in the wet season and all seasons, respectively; and padi yields averaged 4218 kg/ha in the wet season and 3907 kg/ha in the second season. Also, the change in AIA/DIA from before to after the project was 16 percent in the wet season and 43 percent in all seasons. Over an average period of four years, the increase in yields from before to after the project was 26 percent and 17 percent in the wet and second seasons, respectively.

Based on a percentage criterion for the performance ratio, 17 percent of the projects were classified as excellent, 30 percent as good, 17 percent as fair, and 37 percent as poor. The major problem areas identified in the poor systems were: adverse physical and/or water supply conditions, unfavorable site selection in terms of crop systems and farmers' preferences, the irrigation of areas in the DIA that were already well irrigated before the project, over-reliance on rehabilitating existing physical systems instead of creating new diversion and conveyance systems to serve new areas, and too large a DIA for the system and/or water supply.

ACKNOWLEDGEMENTS

It has been a great honor for P.T. EXSA International Co. Ltd. to serve the United States Agency for International Development (USAID)/Mission to Indonesia in conducting the Sederhana Assessment Study between January 1984 and March 1985.

We would like to extend our appreciation to USAID/Indonesia Director William Fuller and USAID staff, especially Dr. David Seckler, who gave us guidance and counselling throughout the study.

We would also like to express our gratitude to the Director and staff of the Directorate of Irrigation, Ministry of Public Works, the Director and staff of the Directorate of Agricultural and Area Development, Ministry of Agriculture, and the Ministry of Home Affairs, Government of Indonesia.

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Preface

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

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

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

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

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

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

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

1. THE FRAMEWORK OF THE STUDY

1.1 Introduction

By 1983, the Government of Indonesia (GOI) had constructed and/or rehabilitated more than 1,800 small-scale (less than 2,000 ha) irrigation projects throughout the country. These projects were called "Sederhana Projects," now referred to as "Irigasi Kecil." Eight hundred eighty five of these projects received assistance from the United States Agency for International Development (USAID) during the Sederhana I (1974-1979) and Sederhana II (1979-1984) programs. These USAID-assisted projects were completed by December 1983.

In 1983, the Directorate of Irrigation in the Ministry of Public Works, the Directorate of Agricultural and Area Development in the Ministry of Agriculture, the Ministry of Home Affairs, and USAID agreed that it would be valuable to survey a sample of Sederhana projects that had been in operation for at least two years. The survey results would then be used to determine the projects' impact on irrigated areas, the present condition of their works, and other aspects of interest. Accordingly, USAID contracted with P.T. EXSA, an Indonesian consulting firm, to survey a sample of 30 of the projects sponsored by USAID in the four provinces of West Java, North and West Sumatra, and South Sulawesi.

The results of this study are presented in two forms. First, this report describes the survey methodology, and provides an overview of all 30 projects along with a summary of the survey results and technical conclusions. Second, Project Profiles (PP) have been prepared for each of the 30 sample projects. All the data collected in this study are presented in the PPs so that others may perform their own analyses if they wish. These data are also entered on Apple Computer disks. Copies of those disks are available from P.T. EXSA, at cost of reproduction, with the approval of the GOI.

1.2 Objectives and Scope of Work

The objectives of the study were essentially to:

(1) assess the performance of a sample of USAID-sponsored Sederhana projects in terms of the performance criteria discussed in Section 2, and

(2) develop a cost-effective methodology for use in planning new small-scale irrigation projects and in monitoring the performance of existing projects.

The scope of work is depicted in the flow chart of Figure 1. The work was divided into four phases, which are described below.

1.2.1 Phase I (Preparation)

The work carried out in this phase covered the selection of locations, and collection of secondary data from the GOI and USAID. These data included certificates from each project, contour maps of irrigation planning, diagrams of irrigation networks, and climatic soil and discharge data. In one case (Cibanten), where aerial photographs were available, the results of the land survey technique were checked against the photographs. The land survey was accurate to within $\pm$ 5 percent. In this phase, survey permits for each project were obtained from the GOI.

1.2.2 Phase II (Field Survey)

The field survey covered the physical condition of the irrigation works, land-use, the extent of irrigated and non-irrigated land, collection of socio-eonomic and agricultual data from government offices, and interviews with farmers in the project areas.

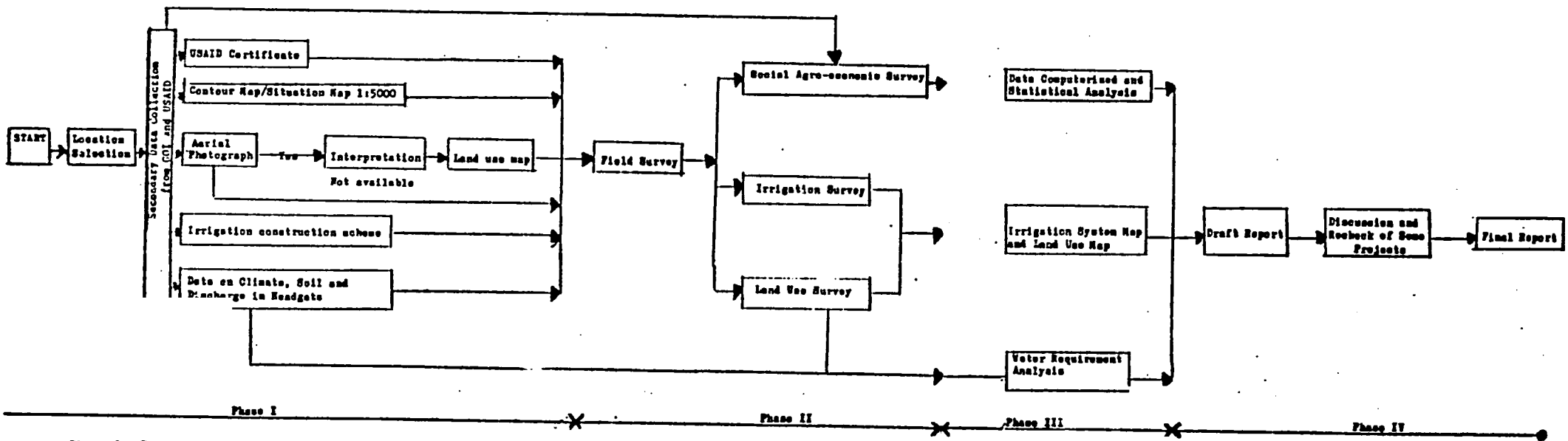

Figure 1. Flowchart of Sederhana Assessment Study

1.2.3 Phase III (Mapping and Data Analysis)

In this phase, irrigation networks, land-use, and irrigated land were mapped. A topographical map with a scale of 1:5,000 was used as a base map. Also, data collected from interviews with 40-50 farmers in each project were compiled and analyzed. Irrigation water requirements were also analyzed.

1.2.4 Phase IV (Reporting and Discussion)

The draft report and PPs were reviewed with provincial and local GOI officials. Field checks were made and corrections incorporated in the final report and PPs.

1.3 Methodology

1.3.1 Selection of the Projects

The projects selected and descriptions of them are shown in Figure 2 and Table 1, respectively. The selection process was random, subject to certain conditions:

(1) Projects were selected within provinces of particular interest to GOI in terms of future small-scale irrigation projects. This criterion resulted in the selection of projects in four provinces: West Java (10 projects), South Sulawesi (10 projects) and North and West Sumatra (10 projects).

(2) Within these provinces, clusters of five to ten projects were selected to minimize transportation costs and the time spent travelling between projects.

(3) Projects were chosen that had been officially opened for at least two years.

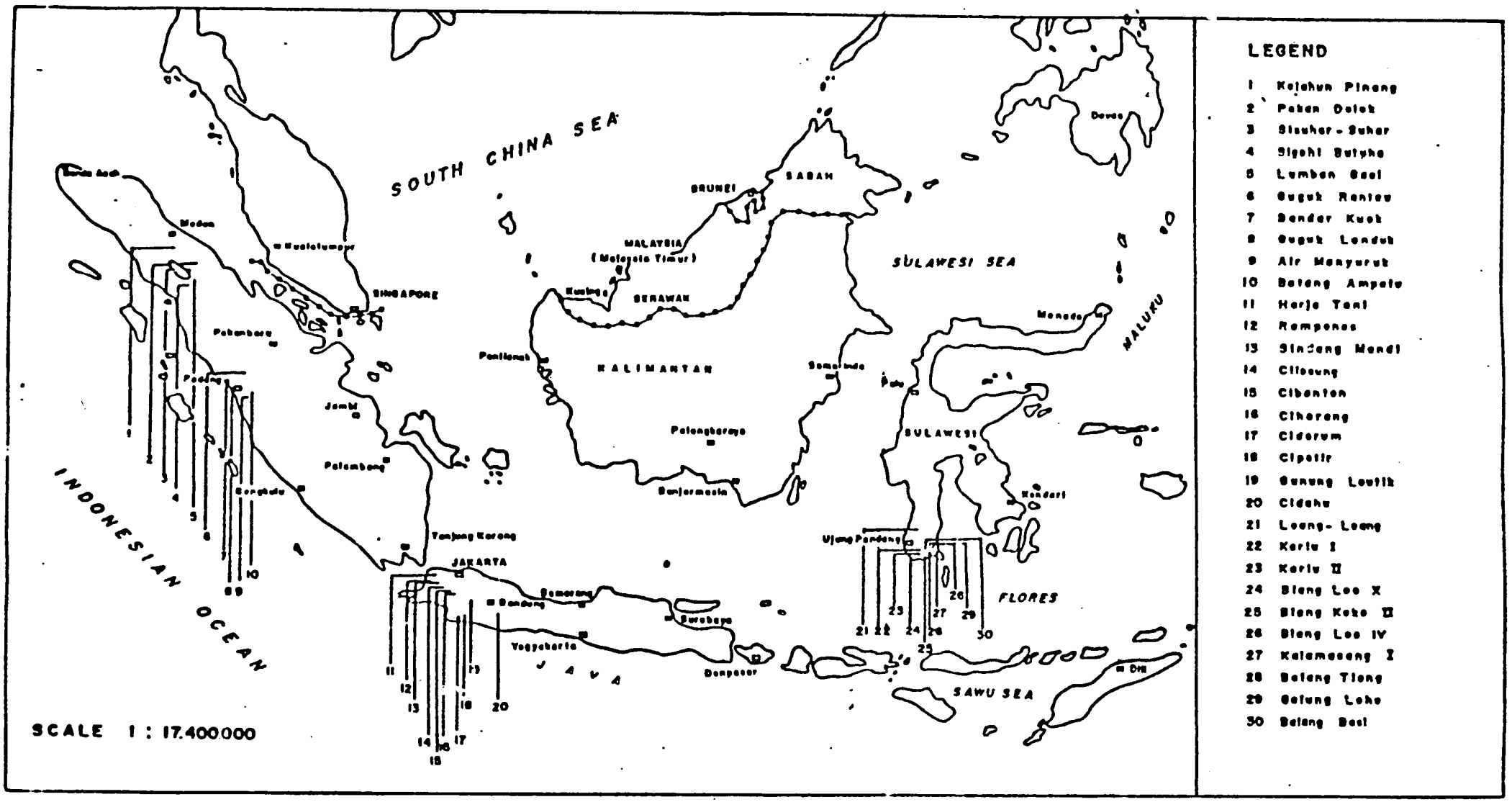

Figure 2. Location Map of Sederhana Irrigation Projects

Table 1. Description of Each Project

District	Project No.	Location	Designed Irrigated Area (ha)	Year of Program SI	SII 79/80	SII 80/81	N	Status** C	I
NORTH SUMATRA									
Deli Serdang	1.	Kelahun Pinang*	530		x	x			x
	2.	Pekan Dolok	625		x	x	x		x
Tapanuli Utara	3.	Sisuhar-Suhar	600			x	x		
	4.	Sigohi Butuha	196			x	x		
	5.	Lumban Gaol	217	x	x				x
WEST SUMATRA									
Solok	6.	Cuguk Rantau	416			x	x		
	7.	Bandar Kuok	525	x					
	8.	Cuguk Landuk	236			x	x		
	9.	Air Manyuruk	314	x					
	10.	Batang Ampalu	191			x	x		
WEST JAVA									
Serang	11.	Harja Tani	92		x		x		
	12.	Rampones	125			x	x		
	13.	Sindang Mandi	109		x		x		
	14.	Cilesung	215		x		x		
Bogor	15.	Cibanten	326		x	x	x		
	16.	Ciherang	299			x	x		
	17.	Ciderum	150	x					
Cianjur	18.	Cipetir A	80	x					
	19.	Gunung Lautik	50		x		x		
Garut	20.	Cidahu	280		x		x		
SOUTH SULAWESI									
Maros	21.	Leang-Leang*	709	x	x			x	
Bantaeng	22.	Kariu I	448	x					
	23.	Kariu II	185	x					
	24.	Biang Loe X	170			x	x		
	25.	Biang Keke II*	218		x		x		
	26.	Biang Loe IV	450	x					
	27.	Kalimasang I	726		x		x		
Bulukumba	28.	Balang Tieng	358		x		x		
	29.	Calung Lohe	961		x		x		
	30.	Balang Besi	668			x			

* Project HPSIS (High Performance Sederhana Irrigation System)
** Status: N = New, C = Continuation, I = Improvement.

(4) Availability of basic irrigation design maps for each project was required.

Together, these 30 projects represent approximately 10 percent of the total Sederhana Projects in the four provinces.

1.3.2 Secondary Data Collection

Data from each project were collected both from USAID and from the Government of Indonesia at the propinsi (provincial), kabupaten (regency), kecamatan (sub-district) and kelurahan (village) levels. A description of the collection efforts, survey methodology problems encountered, and suggestions for future research are presented in this section.

The material collected included data on the certificates of each project, contour maps of irrigation network planning on a scale of 1:5,000, irrigation network diagrams, population and farms, land-use, kinds of crops and production, Water User Associations' (P3A) data on irrigation discharge, extent of irrigated land, climatic data and other supporting data. If climatic data such as rainfall, evaporation, percolation, etc. were not available for the location of a project, the data were obtained from the nearest weather station.

1.3.3 Project Surveys

Three different kinds of surveys were conducted for each project. They were surveys of irrigation works, irrigated areas and land use, and farmers.

Survey of the Irrigation Works

The physical works from the weir to the tail of the primary canals were inspected. Their condition and the condition of the canal (good, fair, or poor) were recorded, photographed and reported in the PPs.

Survey of Irrigated Areas and Land Use

Using the original design maps of the projects, lines perpendicular to the primary canal (rentis lines) were drawn to the edge of the designed irrigated area (DIA) at a distance of between 100 to 300 meters, depending on the size of the DIA of the project (see Figure 3 as an example). A minimum of 10 rentis lines were used for each project. Distance measurements were taken along the rentis lines using a Suunto compass.

The surveyors then walked the entire length of each rentis line observing and recording: (a) the presence/absence of irrigation facilities; (b) crops being grown; and (c) fields with and without irrigation. Informal interviews were also conducted with farmers along the rentis lines to determine if the area was irrigated in the wet season or not, and the boundaries of the irrigated area. A sample of the farmers that have wet season irrigation was selected for formal interviews, as explained below. The basic maps of irrigated area and land use in the PPs were obtained from these observations and the interviews.

In certain large systems, for example, in West Sumatra, the irrigated area was so fragmented that the rentis line survey method would not yield sufficiently accurate observations. In these systems, the closed polygon method was used. This system consists simply of finding the irrigated areas and mapping their peripheries.

It should be noted that these field survey methods, designed to obtain accurate maps of actual irrigated area (AIA) and land use, are much more labor intensive than simple surveys designed to estimate the proportions of AIA and land use in an area. In the latter case, a random sample of farmers within the DIA would suffice. However, it was believed to be well worth while to go through the more difficult mapping process

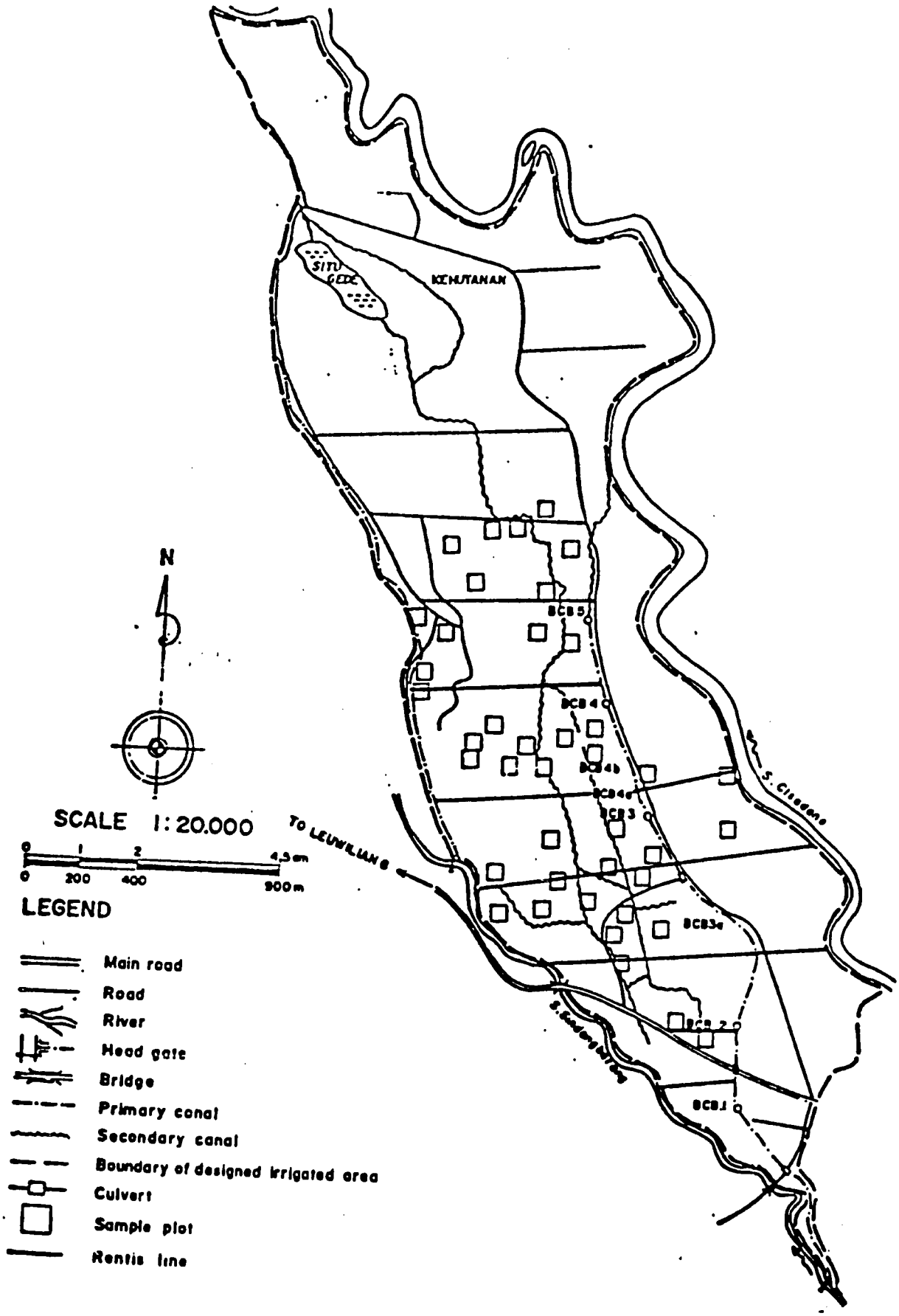

Figure 3. Rentis Line of Cibanten

so that the irrigated and non-irrigated areas, and crop areas could be clearly defined and observed for diagnostic purposes.

A subject for future studies to address is optimization of these field surveys so that maps within reasonable confidence intervals can be obtained with minimal survey work. This subject is not adressed in this report. However, as noted before, tests against aerial photographs and varying spacing of the rentis lines in the Cibanten project indicate the maps are within a ± 5 percent error margin. This may be too accurate, from a cost point of view, for studies of this nature.

Farmer Survey

A sample of 40-50 farmers was selected at the head, middle, and tail of the AIA, as defined by the irrigation map, both along the length and width of the system. These samples were taken systematically, mainly along the rentis lines. While selection of the samples was not a strictly random process, there is no reason to believe a bias was introduced.

In all but a few of the projects (noted in the PPs), the interviews were held only with farmers who do have irrigation in the wet season--i.e, with few exceptions, farmers without irrigation were not interviewed. Neglecting farmers without irrigation in the sample was clearly a mistake that should be rectified in future studies. A sample of farmers without irrigation would provide valuable information for the study on crops, yields, income, and the economic returns to irrigation.

There is also a remote possibility that failure to interview farmers without irrigation could lead to an underestimation of AIA. However, it is believed that this did not occur in this survey because when preparing the map of irrigated areas, farmers at the periphery of the AIA were asked if they had ever received irrigation. Thus, the AIA was checked with farmers at the map-making stage.

Because the study was conducted in all the projects during the months of February to April, 1984 when water supplies were generally high, the wet season AIA was assumed to be at or near its maximum. Precipitation during this period was assumed to be normal (the data are not yet available). Therefore, there should be no bias in estimating wet season AIA because of timing or precipitation.

With two exceptions (Projects Kariu I and Biang Keke II), which practice rotation between different areas in the wet and dry seasons, all farmers who have irrigation in the second and/or third season also have irrigation in the wet season. Thus, the set of farmers with wet season irrigation includes all farmers with irrigation at any time (with the two exceptions, which were specifically studied to correct this possible error).

These considerations are important for understanding some of the recall and subjective questions in the survey. For example:

- A project may irrigate only a small part of the DIA, but 100 percent of the farmers interviewed may be satisfied with their irrigation service. This is because only those farmers receiving irrigation were interviewed. It would be absurd to ask a farmer without irrigation if he were satisfied with the irrigation system. This "satisfaction" question, while highly subjective, possibly indicates: (1) the reliability of delivery of irigation water; (2) the quality of service the farmers have historically received; (3) the desire of farmers who receive irrigation for improvements in the system; or (4) all of the above.

- An irrigation system is dynamic, changing over time. However, this study is only cross-sectional, at a point in time. In an attempt to capture some of the dynamic changes in this

cross-sectional study, recall questions were asked of farmers about their pre-project irrigation and yields by seasons. While the responses may be questioned, there is no particular reason to doubt the farmers' veracity, to the best of their ability, in recalling the pre-project status of irrigation and yields.

It is important to realize that because these recall questions were asked of the set of farmers with current wet season irrigation, it is unlikely that any farmers who had irrigation before the projects began were missed. Again, however, there is one exception--project Cidahu, which experienced a landslide. We understand that this problem has been corrected since the study was conducted. However, the data reflect the state of the project at the time.

The two special study cases mentioned above (Kariu I and Biang Keke II) show the importance of having general background information for each project. Such information should be obtained from conversations with farmers and local officials, prior to conducting detailed interviews, so that appropriate adaptations in the structure of the study can be made.

The farmers were also asked about their yields <u>after</u> the project. Actual yield measurements were <u>not</u> taken in this study because this activity is very difficult and time consuming, and this was principally an irrigation study. However, there is no particular reason to doubt the accuracy of these yield figures, to the best of the farmers' ability to estimate their yields. In fact, as noted in the conclusions below, the reported yield figures appear to correspond quite closely with official yield statistics.

The farmer survey questionnaire is shown in Appendix A and the original data are presented in the PPs. Also, a correlation matrix for these data is presented in each PP. All cells in the correlation matrix with a value of less than 0.20 (R^2=0.04) have been omitted to highlight the more important correlations.

The original data have been repeatedly inspected for errors, outliers, and inconsistencies. However, in a set of over 1,200 observations, some mistakes undoubtedly remain. The reader is urged to note any problems detected and send them to P.T. EXSA for correction.

1.3.4 Irrigation Requirements

Basic data on 10 years of monthly precipitation and other climatological variables were gathered for each project and are presented in the PP. Pan evaporation data were used to make rough estimates of the irrigation water requirement for each project. No attempt was made to measure or estimate effective rainfall, or actual percolation and transpiration/evaporation losses.

The figures shown in the PP are based on generally used coefficients for padi in Indonesia. Total rainfall was used in these estimates because all the padi fields are bunded and therefore, all the rainfall is captured and held for irrigation up to the level of the spillway on the bund.

1.3.5 Organization and Management of Irrigation Systems

Without detailed and prolonged study it is extremely difficult to understand how any irrigation system is organized and managed. Interviews were conducted with farmers, local officials, and village leaders in an attempt to understand these systems' organization and management. However, the information obtained is highly subjective.

Irrigation management is not a variable that can be measured with great accuracy, nor is it given much emphasis in this report. The intent of this study has been to describe what is happening in these projects; all but the most obvious and technical answers as to why and how it is happening were beyond the scope of work.

1.3.6 A Further Note on the Sampling Procedure

A statistical problem that was not sufficiently appreciated at the beginning of this study is the importance of a rigorous random sample of farmers with respect to location in the DIA. Such a sample would allow the definition of changes in the AIA, both before and after the project.

A systematic sample, if not very carefully controlled, can yield biased results. This is because any expansion of the AIA as a result of the project is likely to occur on the periphery of the previous AIA. If the proportion of farmers interviewed that are on the periphery of the old AIA is equal to the proportion of the farmers benefiting from additional AIA, the estimate will be correct. However, if the sample is biased toward, or away from, farmers on the periphery, then the additional AIA will be over- or under-estimated.

For example, USAID recommended that samples be taken on each rentis line as follows:

- A sample on the outer right hand periphery of the AIA.
- A sample on the outer left hand periphery of the AIA.
- A sample in the middle of the AIA on the rentis line.

So long as the additional AIA occurred toward the tail of the system, and not on the sides of the system, this systematic sample would yield accurate results. If, however, the additional AIA occurred through widening, rather than lengthening, the system, this procedure could over-estimate the increase in AIA, because two out of three samples would be on the ends of the rentis lines.

Analysis of the data in the PPs shows that, fortunately, most of the samples are concentrated toward the tail of the system, not along the width. Therefore, the sample should not be biased due to the systematic sampling procedure.

In principle, the best way to sample is to over-lay a numbered grid on a map of the DIA (of, say, 2 ha cells) and randomly sample the grid to locate sample farmers. Of course, given the home addresses of sample farmers, it would not be necessary to interview farmers in the field. Rather, they could be interviewed in the evenings at their homes. This would be the quickest and easiest way to conduct surveillance-level analysis of projects. After these data are analyzed, then, where necessary, another sample could be taken. This sample could be stratified by irrigated and non-irrigated areas. In projects where more detailed diagnostic analysis is needed for remedial action, the field survey techniques discussed above would be used to produce maps.

It is recommended that in future studies both the rigorous random sample and step process be followed. Where the surveillance-level observations (including inspection of works) show either that a project is performing very well or is non-operational, no further survey work is needed. The much more labor-intensive mapping process and second stratified sampling procedure would be used only for projects requiring remedial action. In the case of the present set of projects, perhaps less than 50 percent would require the second stage.

2. PERFORMANCE CRITERIA

2.1 Objectives of the Project and Performance Indicators

The Sederhana Irrigation Project had three major objectives:

(1) To upgrade and extend the physical works of the irrigation system--the weirs, primary and secondary canals, outlets, and drop structures.

(2) To provide reliable irrigation to farmers in the DIA, at least during the wet season.

(3) To provide irrigation in the second and third seasons, insofar as water is available.

These are the objectives of the Sederhana Project *per se*. Of course, the ultimate *goals* to be served by these objectives are increased agricultural production and increased incomes for rural people.

The primary index of performance in this assessment is the relationship between the actual irrigated area (AIA) in the wet season (WS), as determined by the surveys, and the design irrigated area (DIA), or the percentage: AIA/DIA (WS). This percentage was computed both for AIA in the wet season only, and for the sum of AIA in all seasons (or the irrigation intensity). The primary criterion for project effectiveness is AIA/DIA (WS). Obviously, a project that irrigates the same amount of land in two or more seasons is better than one that irrigates in only one season. However, WS irrigation was chosen as the primary criterion to avoid discriminating against projects that do not have second or third season water supplies.

The AIA/DIA performance indicators were considered in essentially two dimensions: first, in terms of their present state, and second, in terms of the amount of change before and after the project. Since there were no baseline studies of the pre-project status of AIA, information on the change in AIA depended on farmers' recall of whether or not they had irrigation before the project.

One of the most difficult problems encountered in this study was not, as expected, measuring AIA, but rather, arriving at a realistic definition of DIA. While the certification papers provide the official DIA for each project, problems arose because in the planning and design stages of the Sederhana projects, surveys were taken only at 2.5 m intervals. Therefore, because of this inadequate land-use survey technique, the DIA may contain:

- Settlements, roads, state forests, and other non-agricultural land, some of which may have been developed since the original DIA survey.

- Land with elevation above the irrigation systems, especially in undulating areas.

- Land that has not been cleared of trees and shrubbery, or otherwise prepared for irrigation. In some cases, this land was rocky, sandy land not suitable for padi irrigation.

- Rubber plantations and other perennial crops that do not need irrigation and which farmers do not want to change to irrigated crops.

- Many systems obtain a significant amount of their water supply, not from the weir, but from drainage from higher irrigation sytems. On the other hand, drainage from the project may irrigate land outside the project's DIA, while failing to irrigate all the land within the project's own DIA.

These complications are discussed in the relevant PP. For the purposes of this report, the most important point is the problem of defining a "project" where two different, or inter-mixed, irrigation systems irrigate the same DIA. The question was whether to include the AIA of the other system in the DIA of the project or not. It was decided to subtract the AIA of the other system from the DIA of the project. The reasons are: (1) the project should not be penalized for failing to irrigate an area that is already irrigated and (2) the project should not be rewarded for an AIA that it does not irrigate, even though that area is included in the project DIA.

In certain projects, as explained in the PPs, farmers in the AIA of the other systems were not interviewed. The interviews were restricted to farmers in the AIA of the project. This should not cause a significant problem, so long as it is recognized.

2.2 Non-Operational and Problem Projects

One project (Leuwi Bitung, West Java) was found to be non-operational because the weir had been damaged. Therefore, it was never included among the sample of 30 projects in the original survey. In addition, four of the 30 projects selected were also considered to be basically non-operational due to clearly identifiable flaws in site selection or their structures. These non-operational projects, and the causes, are listed below.

- B. Ampalu (West Sumatra): 90 percent of the DIA is in an established rubber plantation.

- Biang Keke II (South Sulawesi): This project has a severe water supply shortage at the weir, and rocky land that has not been prepared for irrigation.

- Kalamasang I (South Sulawesi): This project experienced the same problems as Biang Keke II.

- Balang Bassi (South Sulawesi): A large rock blocks the right bank canal, which supplies over 60 percent of the DIA. this rock existed before the project and was not removed or avoided in constructing the canal. Also, part of the canal appears to be higher than the inlet.

In addition there are three cases that were not considered to be non-operational, but have notable problems.

- Pekan Dolok (West Sumatra): This project is subject to heavy and continuous sedimentation of sand in the canal. Most of the DIA is irrigated from breaks in the embankment of the river.

- Galung Lohe (South Sulawesi): The left bank, which supplies over 70 percent of the DIA, is not completed due to the refusal of a land owner to permit construction on his land.

- Cidahu (West Java): This project was damaged by a landslide after the project was constructed. However, the DIA was <u>not</u> adjusted in this case. The damage was corrected after the survey was conducted.

It is notable that of these seven non-operational and problem cases, four are located in South Sulawesi. Similarly, in the six adjusted DIA projects, five are in South Sulawesi. Difference between provinces are discussed further below.

3. SUMMARY OF THE TECHNICAL FINDINGS

3.1 Criteria

The effectiveness of the Sederhana Irrigation projec ıssessed in terms of the following criteria:

- o The condition of the physical works and canals.
- o The Actual Irrigated Area (AIA) in the wet season (WS) as a percentage of the Designed Irrigated Area (DIA):AIA/DIA (WS).
- o The AIA/DIA for all seasons (AS), i.e., the sum of the wet, second and third seasons: AIA/DIA (AS).
- o Padi yields in the wet season and second season.
- o The change in the above three factors from before the project (BP) to after the project (AP): AP/BP.

Of these five criteria, the AIA/DIA (WS) ratio, and the change in this ratio from before the project to after the project, were considered to be the primary indices of performance of the irrigation systems *per se*. The AIA/DIA (AS) ratio is of course more important, but it may be constrained by non-availability of water in the second and third seasons.

3.2 Results

Table 2 shows the projects, grouped by province and by the major variables considered in this study. The second part of Table 2, the glossary, explains the columns in the table.

It was found that there were four basically non-operational projects (described in Section 2.2). Statistics on these projects are not included in the performance averages for the remaining 26 operational projects. The average results for the five criteria listed above are as follows (the numbers in parentheses refer to column numbers in Table 2).

1. Eighty-six percent of the physical structures (9) and 80 percent of the canals (10) are in good condition.

2. The projects irrigate 72 percent of their DIA in the wet season (5).

3. The projects irrigate 142 percent of their DIA in all seasons (6).*

4. Padi yields (dry gabah on the irrigated area) averaged 4218 kg/ha in the wet season (12), and 3907 kg/ha in the second season (14). This compares with an all-Indonesia average of wet land rice of 5141 kg/ha under Bimas/Inmas and 3509 kg/ha without Bimas/Inmas.

*Note that this figure is inflated by counting third season irrigation as a full season (for a maximum potential irrigation intensity of 300 percent), while it should probably be counted as only one-half season with a potential maximum of 250 percent.

Table 2. Performance of SAS Projects by Province

PROJECT	PROV	IRRIGATION PROJECT YEAR	SASKI NOMINAL PROJECT DIA	FROM OTHER SYSTEMS	SASIFIIC PROJECT DIA ADJ	PROJECT DIA/DIA ADJ VSI	PROJECT DIA/DIA ADJ ASI	CHANGE IN YS AP/PP	CHANGE IN AS AP/PP	STRUCT GOOD %	CANAL GOOD %	IRR FARM SAT %	YIELDS YIELD AP YS KG/HA	CHANGE YLD YS AP/PP	YIELD AP ZS YS/HA	CHANGE YLD ZS AP/PP	INCOME TOTAL INCOME PA	INCOME FROM FARMING	INCOME FROM OTHER	FACTO-- NO. VILLAGES	VIEW NEW=1 INF=2	OWNER-SHIP %	INFRA VARIETY PADI %	AREA PADI YS KG/HA	IRRAS 1=YES 0=NO	DIRAS 1=YES 0=NO
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1 CIMANUK	W JAVA	81	229		229	0.90	1.29	1.00	1.00	100	100	71	4397	1.25	4595	1.21	314	211	103	1	1	93	93	192	1	1
2 G. LEDERI	W JAVA	00	50		50	0.00	1.01	1.00	1.05	05	100	100	4953	1.17			342	110	224	2	2	37	0	270	1	1
3 CIDAMI	W JAVA	00	200		200	0.60	1.22	1.00	1.52	90	75	31	3735	1.01	3880	1.00	540	295	245	2	2	44	29	262	1	1
4 CIPEGIR	W JAVA	81	00		00	0.05	1.70	1.00	1.00	65	75	100	5071	1.20	4628	1.19	301	130	171	1	1	0	95	270	1	1
5 CIMIPUN	W JAVA	77	150		150	0.67	1.33	1.02	1.37	00	100	93	5766	1.30	5553	1.32	610	267	343	2	2	90	70	199	1	1
6 CILESING	W JAVA	09	215	63	152	0.69	1.20	2.91	3.81	07	00	100	4710	1.01	4810	1.06	500	106	94	2	2	07	71	176	1	1
7 PONJATANI	W JAVA	00	92		92	0.35	0.60	1.03	1.17	75	40	70	4413	1.00	4259	1.06	490	402	0	1	1	199	93	134	1	1
8 RANTOMES	W JAVA	01	125		125	0.70	1.01	1.03	2.67	05	75	60	3512	1.06			106	109	77	1	2	97	0	106	0	0
9 CIPARIEN	W JAVA	77	326		326	0.52	1.15	1.01	1.10	100	95	60	5160	1.01	4752	1.11	537	397	139	3	2	64	19	272	1	0
10 S. HANOI	W JAVA	00	199		199	0.35	0.70	1.01	1.01	33	30	61	4561	1.05	3813	0.99	222	138	134	2	1	199	0	204	0	0
11 S. LAMBUR	W SUM	01	236		236	0.01	2.01	1.01	1.06	109	100	100	3210	1.23	3194	1.22	261	206	55	1	1	51	100	100	1	0
12 B. LUPU	W SUM	77	525		525	0.70	2.10	1.07	2.05	100	91	100	3210	1.18	3227	1.00	466	416	50	0	1	61	100	175	1	1
13 B. BANTAN	W SUM	01	116		116	0.76	2.29	1.01	1.70	100	97	100	3332	1.22	3593	1.22	227	149	59	0	1	69	100	200	1	0
14 B. MARYUNUR	W SUM	79	191		191	0.67	0.91	1.00	1.00	97	85	90	2779	1.09			300	217	71	1	2	89	61	17	1	0
15 P DOLOK	W SUM	00	625		625	0.86	1.72	1.00	1.00	09	00	50	6015	1.51	5557	1.67	1216	1149	67	6	2	100	97	290	0	1
16 SISIMAR-SUMAR	W SUM	01	600		600	0.05	0.90	1.51	1.10	07	90	07	4011	1.37			537	117	122	6	1	100	0	171	0	1
17 L.BAGI	W SUM	09	212		212	0.90	1.23	1.08	1.93	90	95	53	5237	1.16			476	340	90	2	1	100	0	141	0	1
18 S PUTIHA	W SUM	02	220		220	0.01	0.07	1.00	1.07	01	35	16	4711	1.25			659	449	210	2	1	100	11	132	0	1
19 P PINANG 000	W SUM	75	539		539	0.11	0.05	1.30	1.10	93	100	97	5115	1.16	4957	1.50	1053	1699	165	6	2	100	100	161	0	1
20 BABIN II	S SUL	77	105	70	111	0.90	1.96	1.00	1.00	90	71	60	3157	1.12	2722	1.23	382	225	157	1	1	07	100	179	1	1
21 BABIN I	S SUL	77	112		112	0.10	0.07	1.00	1.00	100	96	50	2591	0.98	2110	0.93	301	217	51	1	2	95	78	116	1	0
22 B. LOE IV	S SUL	77	101		101	0.09	1.29	1.00	1.00	109	72	32	4011	1.01	4036	1.05	895	875	20	1	2	03	07	237	1	0
23 B. TIENG	S SUL	00	350	02	226	0.03	2.10	1.00	1.73	73	61	25	3165	0.96	2910	0.96	066	037	29	1	1	96	100	172	1	1
24 G. LOPE	S SUL	09	960	652	309	0.90	1.61			100	70	11	3013	1.01	2103	1.02	693	660	20	1	1	69	100	151	1	0
25 L. LEANG 000	S SUL	09	799	01	620	0.03	0.07	1.00	1.00	05	07	02	3252	0.29			330	301	37	2	2	91	100	251	1	0
26 B. LOE I	S SUL	01	170		170	0.91	1.01	1.00	1.00	50	100	67	4210	1.13	3564	1.12	440	353	95	1	0	31	98	195	1	1
27 P. ANTALU	W SUM	01	191		191	0.09	0.09	1.00	1.00	100	100	100	3091	1.22			102	124	58	1	2	77	62	73	1	0
28 B. BEKE II 000	S SUL	00	210		210	0.07	0.26	2.01	3.00	100	67	40	1672	1.12	1567	1.21	403	300	103	1	1	73	35	151	1	0
29 PALANGSANG	S SUL	00	726		726	0.17	0.19	1.50	1.70	100	87	0	3160	1.11			377	279	99	1	1	90	100	156	1	1
30 PALANGKOSI	S SUL	01	049	179	271	0.25	0.51	1.00	1.01	100	93	35	3012	1.05	2765	1.17	759	715	44	1	1	68	90	199	1	1
OPERATIONAL PROJECTS	AVER	79.50	350		290	0.72	1.02	1.06	1.03	86	80	60	4210	1.26	3707	1.17	544	432	111	2.31	1.02	76	69	190	0.73	0.62
000 UPSIS SIMS	SD	1.72	210		179	0.19	0.53	0.06	0.66	16	21	29	950	0.05	910	0.07	350	353	04	1.61	0.57	26	02	63	0.00	0.00
	MIN	75.00	50		50	0.35	0.07	0.00	0.00	33	30	11	2579	0.96	2103	0.89	106	109	0	1.00	0.00	0	0	17	0.00	0.00
	MAX	02.00	961		620	0.90	2.40	2.91	3.03	100	100	100	6015	3.29	5557	0.05	1853	1600	373	6.00	2.00	100	100	350	1.00	1.00
	WJAVA	29.70	166		159	0.60	1.30	1.20	1.51	01	77	76	4606	1.13	4539	1.10	420	262	159	2.00	1.00	71	46	227	0.00	0.70
	WSUM	00.00	300		300	0.75	1.03	1.01	1.70	97	91	100	3035	1.10	3251	1.17	316	257	59	2.50	1.25	65	05	105	1.00	0.75
	ESUM	77.60	039		039	0.70	1.03	1.30	1.30	07	00	65	5127	1.04	5297	1.63	949	010	139	0.00	0.00	046	02	161	0.00	1.00
	SSUL	70.06	050		352	0.07	0.57	0.00	0.12	05	75	02	3520	1.16	2961	1.05	560	500	60	0.10	0.29	29	95	109	1.00	0.02

Table 2 (continued)

Glossary

Column #	Description
1	The budget year in which work started on the project, e.g., 1979-1980 shown as 1980
2	As defined in project reports (DIA - Designed Irrigated Area, wet season)
3	An area in the DIA, but not irrigated from the project source
4	Column 2 minus column 3
5	Actual Irrigated Area (AIA) divided by column 4 in wet season (WS)
6	Same as column 5, but for all sesons (AS) - the sum of WS, second season (2s), and third season (3s)
7	AIA (WS) AP (after project) divided by AIA (WS) BP (before project)
8	Same as column 7 but for AS
9	Surveyor's judgment on condition of the structure
10	Surveyor's judgment on condition of the canals
11	Percentage of farmers who have irrigation (WS) and are satisfied with the irrigation system
12	Yield of dry gabah [unhulled rice (x 0.62 = polished rice)] in the wet season
13	Change yield (yld) in WS between AP and BP
14	Same as column 12 but in the second season
15	Same as column 13 but for 2s
16	Net income per household not counting out-of-household earners
17	Income from farming
18	Income from other than farming

Table 2 (continued)

Column #	Description
19	Number of villages in the DIA
20	Weir status (new or improved)
21	Percent of sawah owned by farmers
22	Percent of farmers using improved padi varieties
23	Area of padi (WS) in kg/ha
24	Participated in Inmas program (yes or no)
25	Participated in Bimas program (yes or no)

5. The change in AIA/DIA from before the project to after the project was 16 percent in the wet season (7) and 43 percent for all seasons (8).
6. The increase in yields from before to after the project was 26 percent in the wet season (13), and 17 percent in the second season (15) over an average period of four years (1).

3.3 Assessment

In order to assess these results, it was necessary to have some criterion of good performance. In this case, the AIA/DIA (WS) ratio was used as the performance criterion. However, simple performance averages tend to hide the diversity of results between projects and provinces. This section provides an illustrative analysis of these considerations.

First, Table 3 shows the rank ordering of the projects listed in Table 2 (excluding the non-operational projects) in descending order by the AIA/DIA (WS) ratio. This table orders all of the projects in Table 2 so that comparisons can be made across the rows.

Table 4 shows the results of a rather arbitary classification of performance in terms of the AIA/DIA (WS) percentage criterion: "excellent" over 89 percent; "good" (89 percent to 75 percent), "fair" (75 percent to 60 percent) and "poor" (under 60 percent) for all 30 projects, by province. It can be seen from Table 4 that about one-half of all the projects are in the excellent and good classes, with the other half in the fair and poor classes. The data on the provinces speak for themselves. However, it is interesting to note that South Sulawesi had the highest frequency of both excellent and poor projects.

Table 3. Performance of SAS Projects, by Rank

	PROJECT	PROV	IRRIGATION PROJECT YEAR	SASRA NOMINAL PROJECT BIA	FROM OTHER SYSTEMS	SASIFIIC PROJECT BIA ADJ	PROJECT BIA/BIA ADJ WSE	PROJECT BIA/BIA ADJ ASE	CHANGE IR WS AP/BP	CHANGE IR AS AP/BP	STRUCT GOOD I	CANAL GOOD I	IRR FARM SAT I	YIELDS YIELD AP WS KG/HA	CHANGE YLD WS AP/BP	YIELD AP 2S KG/HA	CHANGE YLD 2S AP/BP	INCOME TOTAL INCOME PA	INCOME FROM FARMING	INCOME FROM OTHER	FACTORS NO. VILLAGES	WIER NEW=1 IMP=2	OWNER-SHIP I	IMPRO VARIETY PADI I	AREA PADI HS KG/HA	BIMAS 1=YES 0=NO	BIMAS 1=YES 0=NO
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	20 BARIU II	S SUL	77	185	78	181	0.98	1.96	1.00	1.00	90	74	68	3157	1.12	2727	1.23	382	225	157	1	1	82	100	179	1	1
	17 L.GADI	N SUL	00	217		217	0.98	1.23	1.68	1.93	94	95	53	5239	1.16			476	388	88	2	1	100	0	141	0	1
	26 B. LOE I	S SUL	01	170		170	0.91	1.81	1.00	1.00	50	100	69	4218	1.13	3564	1.12	448	353	95	1	0	31	98	195	1	1
	24 G. LOKE	S SUL	00	961	652	309	0.98	1.61			100	78	11	3113	1.01	2183	1.02	688	666	20	1	1	68	100	151	1	0
	1 CIMERANG	W JAVA	01	229		229	0.98	1.79	1.00	1.00	100	100	71	4397	1.23	4595	1.21	314	211	103	0	1	93	93	192	1	1
	22 B. LOE IV	S SUL	77	401		401	0.09	1.79	1.00	1.00	100	72	32	4041	1.01	4036	1.05	895	875	20	1	2	49	87	237	1	0
	2 G. LEGEIV	W JAVA	00	50		50	0.00	1.01	1.00	1.05	85	100	100	4853	1.17			342	118	224	2	2	37	0	270	1	1
	15 P BOLOK	N SUL	00	625		625	0.86	1.72	1.00	1.00	80	80	50	6095	1.54	5557	1.67	1216	1149	67	6	2	100	97	200	0	1
	6 CIPETIR	W JAVA	01	80		80	0.05	1.70	1.00	1.00	65	75	100	5071	1.28	4628	1.49	301	130	171	1	1	0	95	274	1	1
	16 SISUMAR-SUMAR	N SUL	01	699		600	0.85	0.98	1.51	1.48	87	90	87	4094	1.37			539	417	122	6	1	100	0	171	0	1
	27 B. TENG	S SUL	00	358	82	276	0.83	2.48	1.00	1.73	73	61	25	3165	0.96	2848	0.96	866	837	29	1	1	86	100	172	1	1
	18 S PUTUMA	N SUL	02	221		221	0.81	0.87	1.00	1.07	83	35	36	4711	1.75			659	449	210	2	1	100	11	832	0	1
	11 G. LABUR	W SUL	01	236		236	0.81	2.01	1.01	1.46	100	100	100	3218	1.23	3194	1.22	261	206	55	1	1	51	100	188	1	0
	13 G. RADIAL	W SUL	01	416		416	0.76	2.29	1.04	1.70	100	97	100	3332	1.22	3333	1.22	227	160	59	4	1	60	100	200	1	0
	9 BANDUNG	W JAVA	01	125		125	0.70	1.41	1.13	2.67	85	75	60	3952	1.06			186	109	77	1	2	97	0	106	0	0
	12 B. PUDI	W SUL	79	525		525	0.70	2.10	1.09	2.95	100	93	100	5219	1.10	3227	1.08	466	416	50	6	1	61	100	175	1	1
	5 CIDEPUR	W JAVA	77	150		150	0.67	1.33	1.02	1.37	88	100	93	5766	1.38	5553	1.32	640	267	373	2	2	88	78	388	1	1
	10 A. RANTEPAO	W SUL	79	341		341	0.67	0.93	1.00	1.00	97	85	98	2774	1.09			308	237	71	1	2	89	41	17	1	0
	4 CILESUNG	W JAVA	00	215	63	152	0.61	1.28	2.94	3.13	87	80	100	4718	1.01	4818	1.06	580	486	94	2	2	87	71	176	1	1
	7 CIMANU	W JAVA	00	280		280	0.60	1.22	1.00	1.52	90	75	31	3735	1.01	3888	1.00	568	295	273	2	2	44	20	262	1	1
	8 CIMARIEN	W JAVA	77	326		326	0.52	1.15	1.01	1.18	100	95	60	5160	1.01	4752	1.11	517	307	130	3	2	60	10	272	1	0
	21 BARIU I	S SUL	77	432		432	0.44	0.87	1.00	1.00	100	96	50	2594	0.98	2418	0.93	301	247	54	1	2	95	78	116	1	0
	25 L. TEANG III	S SUL	09	709	81	620	0.43	0.47	1.00	1.00	85	47	42	3252	3.29			338	301	37	2	2	81	100	251	1	0
	14 B PEKANG III	N SUL	75	530		530	0.43	0.85	1.30	1.40	93	100	97	5495	1.46	4857	1.58	3953	3688	165	6	2	100	100	161	0	1
	19 S.BANDI	W JAVA	00	109		109	0.35	0.78	1.01	1.01	33	30	63	4567	1.03	3813	0.98	272	138	134	2	1	100	0	200	0	0
	* MARJATAKI	W JAVA	00	92		92	0.35	0.68	1.03	1.17	75	40	70	4643	1.00	4259	1.06	490	482	8	1	1	100	93	134	1	1
	23 B. ANPALU	W SUL	01	191		191	0.09	0.09	1.00	1.00	100	100	100	3084	1.22			182	124	58	1	2	77	62	79	1	0
	28 B. PEKE II	S SUL	00	218		218	0.17	0.26	2.98	3.00	100	67	48	1672	1.12	1567	1.21	443	390	143	1	1	73	35	131	1	0
	29 KALAMASANG	S SUL	00	726		726	0.17	0.19	1.56	1.78	100	89	0	3168	1.11			379	279	98	1	1	90	100	156	1	1
	3 BULANGRASI	S SUL	01	409	178	231	0.25	0.51	1.00	1.09	100	93	35	3812	1.05	2765	1.17	759	715	44	1	1	68	94	180	1	0

Table 4. Frequency Distribution of Projects: AIA/DIA (WS)

	EXCELLENT Over 89%		GOOD 89% - 75%		FAIR 75% - 60%		POOR Less than 60%		TOTAL
W. JAVA	1	10%	2	20%	3	30%	4	40%	10
W. SUMA.	0	0%	2	40%	2	40%	1	20%	5
N. SUMA.	1	20%	3	60%	0	0%	1	20%	5
N. SULA.	3	30%	2	20%	0	0%	5	50%	10
TOTAL	5	17%	9	30%	5	17%	11	37%	30

3.4 Technical Analysis

This section attempts to identify the major problem areas discovered during the Sederhana Assessment. The focus is naturally on the "poor" and "fair" projects, so that in the future these problems can be avoided and improvements made. The analysis of problems here concentrates on observable, verifiable technical factors. Problems of management, which were not specifically studied in this assessment, can be analyzed by others as a residual factor, after the technical factors have been accounted for.

Table 5 shows the same ordering of the projects as in Table 3, with a brief statement of the problem in terms of degree: low to moderate (1) or serious (2). A fuller statement is included in Appendix B and in the project profiles.

Most of the problems occur primarily in the site selection and project design stage. The major problems are:

- Adverse physical conditions of land and/or water supply beyond the control of project managers. These problems either were not anticipated in the selection of project sites, or occurred after site selection and designs were completed.

- Selection of unfavorable sites in terms of crop systems and farmers' preferences. This leads to attempts to irrigate non-irrigated crops, like perennials, that the farmers do not want to irrigate; or in one case (No. 10--S. Mandi in West Java), to divert water from existing padi areas that are not in the DIA to areas of non-irrigated crops within the new DIA.

- Irrigation of areas in the DIA that were already being well irrigated before the project. Thus, of the 26 operational

Table 5. Frequency of Major Problems

Project		Problem I	II	III	IV	OTHER	Description
20 Kariu II	S Sul				2		
17 L. Gaol	N Sum		1				Excess Diversions Upstream
26 B. Loe I	S Sul				2		
24 G. Lohe	S Sul	1					Landowner Refused Permission for Part of Canal
1 Ciherang	W Java				2		
22 B. Loe IV	S Sul				2		
2 G. Leutik	W Java				2		
15 P. Dolok	N Sum	1			2		High Rates of Sedimentation
4 Cipetir	W Java				2		
16 Sisuhar-Suhar	N Sum						
23 B. Tieng	S Sul				2		
18 S. Butuha	N Sum				2		
11 G. Landuk	W Sum				2		
13 G. Rantau	W Sum	1			2		Part of DIA on high ground and new settlements
8 Rampones	W Java			1			Part of DIA or high ground and new settlements
12 B. Kuor	W Sum				2		1 Canal not yet finished due to a death
5 Ciderum	W Java	1		1	2		Part of DIA on high ground and annual crops
14 A. Manyuruk	W Sum	1		1	2		Part of DIA on high ground and annual crops
6 Cilesung	W Java			1			Settlements and annual crops
3 Cidahu	W Java	1			2		Landslide
9 Cibanten	W Java				2		Forest and settlement
21 Kariu I	S Sul	2	2		2		Deficient water supply and poor soils for padi
25 L. Leang (1)	S Sul		2		2		Flume is broken
19 K. Pinang (1)	N Sum						Canals not completed
10 S. Mandi	W Java			2	2		Poor design from padi to annual crops
7 Harjatani	W Java		2		2		Water supply dried up for unknown reason
30 Balangbasi	S Sul				2	2	Canal too high for inlet and rock in canal
28 Biang Keke II (1)	S Sul	2	2				Poor soils for padi, very rocky, high con-
29 Kalamasang	S Sul		2	2	2		veyance losses forest area, deficient water supply, large DIA
27 B. Ampalu	W Sum		2		2		Rubber plantation

Problem Type

I. Adverse Physical Conditions
II. Deficient Water Supply
III. Crop Systems and Farmers Preferences
IV. "Re-irrigation" of existing irrigated area; no change AP/BP; DIA above optimum

1 = Problem present
2 = Serious problem

projects, wet season irrigated area increased less than 10 percent in 21 projects, and less than 10 percent in 14 projects in all seasons.

Related to the last point, there appears to be an over-reliance on rehabilitating the existing physical system, as contrasted with creating new and different diversion and conveyance systems to serve new areas. Existing systems tend to irrigate the same area; new areas often require new and separate facilities.

The DIA may be designed at too large a scale for the system and/or water supply. As shown in Appendix C, this study indicates that the optimal size of a Sederhana system is below 300 ha DIA.

APPENDIX A : Kuestioner Petani

No. Kuestioner :
Sub Proyek :
Propinsi :
Kabupaten :
Kecamatan :
D e s a :
Pewawancara :
Tanggal :

I. IDENTITAS PETANI

1. N a m a : .....
2. U m u r : ..... th
3. Pendidikan : SD/SMTP/SMTA
4. Bisa membaca : ya/tidak
5. Bisa menulis : ya/tidak
6. Luas petak yang dimiliki : ..... ha
7. Letak petak : - dari bendung : ..... m
   - dari saluran primer : ..... m
8. Jenis pemilikan lahan :

Macam pemilikan	Ha	Jumlah petak	Irigasi atau tadah hujan
Milik sendiri			
Sewa			
Bagi hasil			
Lainnya			
T o t a l			

9. Pendapatan petani per tahun
   a. Dari hasil pertanian *) Rp. .....
   b. Dari buruh tani Rp. .....
   c. Dari lainnya ..... Rp. .....
   Total Rp. .....

*) Perinciannya disajikan dalam bagian ke :::.

II. POLA TANAM DAN KEBIASAAN PETANI MENGGUNAKAN AIR

Pola Tanaman	Sebelum ada irigasi (< th .....)						Sesudah ada irigasi (> th .....)					
	MT I		MT II		MT III		MT I		MT II		MT III	
	Jenis tanaman	Masa tumbuh	Jenis tanaman	Masa tumbuh	Jenis tanaman	Masa tumbuh	Jenis tanaman	Masa tumbuh	Jenis tanaman	Masa tumbuh	Jenis tanaman	Masa tumb.
Fase Pertumbuhan	Waktu (hari)	Tinggi air (cm)	Waktu (hari)	Tinggi air (cm)	Waktu (hari)	Tinggi air (cm)	Waktu (hari)	Tinggi air (cm)	Waktu (hari)	Tinggi air (cm)	Waktu (hari)	Tinggi air (cm)
- Pengolahan tanah												
- Penanaman												
- Pertumbuhan												
- Pemupukan I												
- Pemupuka II												
- Pemupukan III												
- Pemetanoan												
- Panen												
- Produksi kg/petak												

III. BIAYA PRODUKSI DAN PENDAPATAN DARI HASIL PERTANIAN

Musim tanam : I/II/III *)

Jenis tanaman yang diusahakan : .....

Luas petak yang diusahakan : ..... ha

A. Nilai sewa tanah Rp. .....

Lainnya Rp. .....

Sub. Jumlah Rp. .....

B. Sarana produksi dan lain-lain

1. Bibit .... kg a Rp. ..... Rp. .....
2. Pupuk buatan :
   - Urea .... kg a Rp. ..... Rp. .....
   - TSP .... kg a Rp. ..... Rp. .....
   - ... . kg a Rp. ..... Rp. .....
3. Pupuk organis .... kg a Rp. ..... Rp. .....
4. Obat-obatan .... lt a Rp. ..... Rp. .....

Sub. Jumlah Rp. .....

C. Tenaga Kerja

Proses	HOK			Biaya
	Pria	Wanita	Ternak	
1. Persiapan lahan	....	.....	.....	Rp. .....
2. Persemaian	....	.....	.....	Rp. .....
3. Penanaman	....	.....	.....	Rp. .....
4. Penyiangan	....	.....	.....	Rp. .....
5. Pemupukan	....	.....	.....	Rp. .....
6. Penyemprotan	....	.....	.....	Rp. .....
7. Pemeliharaan lain	....	.....	.....	Rp. .....
8. Panen	....	.....	.....	Rp. .....
Sub. Jumlah	....	.....	.....	Rp. .....

Keterangan :

Upah tenaga kerja Pria Rp. ...../hari

Wanita Rp. ...../hari

Ternak Rp. ...../hari

Jumlah A + B + C Rp. .....

D. Produksi sebelum/setelah dikurangi bawon *)

..... a Rp. ..... Rp. .....

..... a Rp. ..... Rp. .....

..... a Rp. ..... Rp. .....

Jumlah Rp. .....

E. Pendapatan bersih per musim Rp. .....

*) Coret yang tidak perlu.

IV. INTENSIFIKASI PERTANIAN

1. Keikutsertaan dalam program Bimas : ya atau tidak,
   ya, dalam hal : .....

2. Keikutsertaan dalam program Insus : ya atau tidak,
   ya, dalam hal : .....

3. Keikutsertaan dalam program penyuluhan : ya atau tidak,
   ya, dalam hal : .....

4. Pemasaran produksi : a. memasarkan sendiri
   b. memasarkan ke KUD
   c. Lainnya.

5. Keikutsertaan dalam organisasi P_3A : ya atau tidak,
   ya, dalam hal : .....

6. Sistim pembagian air : a. setiap hari (tidak ada aturan) } sekali
   b. ..... hari/minggu }

V. KARAKTERISTIK ORGANISASI DESA

1. Kondisi organisasi Koperasi Unit Desa :
2. Kondisi organisasi Persatuan Petani Pemakai Air :
3. Kondisi program Bimbingan Masyarakat :
4. Kondisi program Insus :
5. Kondisi program Penyuluhan :

VI. TANGGAPAN PETANI TERHADAP PROYEK :

APPENDIX B: SUMMARY DESCRIPTION OF EACH PROJECT

1. CIHERANG (EXCELLENT)

This project is one of the best performers. The land irrigated in both the wet and dry seasons is 205 ha, or 90 percent of the DIA (229 ha).

2. GUNUNG LEUTIK (GOOD)

This is the smallest project, with a DIA of 50 ha. The system irrigates 44 ha or 88.4 percent of the DIA. The cropping pattern, padi-palawija, was changed to padi-padi after the project.

3. CIDAHU (FAIR)

At the time the field survey was carried out in Feruary 1984, the area irrigated in both the wet and dry seasons was only 169 ha or 60.5 percent of the DIA of 280 ha. This was due to a landslide that occurred in 1982, damaging the canals. Before the landslide the system irrigated 202 ha, according to the farmers.

4. CIPETIR (GOOD)

The total area irrigated by this project (in both the wet and dry seasons) is 68 ha or 85 percent of the DIA of 80 ha. The rest of the area is settlement.

5. CIDERUM (FAIR)

The area irrigated by this project, in both the wet and dry seasons, is 99 ha or 66.5 percent of the DIA of 150 ha. The remaining area is on high ground and planted with perennial crops, e.g., cloves, coconut.

6. CILESUNG (FAIR)

The system irrigates 97 ha or 64 percent of the DIA adjusted area of 152 ha. The remaining area of 65 ha cannot be irrigated because it consists of settlements, graves and some mangrove. Sixty-three ha of irrigated area in the DIA are irrigated from other systems on higher ground.

7. HARJATANI (POOR)

The system irrigates 32 ha or only 35 percent of the DIA of 92 ha. For unknown reasons, the water supply in the Serdang River dried up after the project.

8. RAMPONES (FAIR)

The water sources is from a spring. It irrigates an area of 87 ha or 70 percent of the DIA of 125 ha. The remaining 38 ha consist of settlements and perennial crops which need no watering.

9. CIBANTEN (POOR)

The actual irrigated area in the wet season is 168 ha or 51.5 percent of the DIA of 326 ha. The rest of the area is settlements and forest. Much of the area, which was formerly padi fields, was converted into settlement areas after the project.

10. SINDANG MANDI (POOR)

The irrigated area in this system is only 37 ha or 35 percent of the DIA of 109 ha. The reason for this low utilization appears to be that before the project, water from the spring was irrigating padi outside the DIA and the farmers there broke the diversion works to keep the water. Most of the land in the DIA is planted with perennial crops, which the farmers may not want to irrigate in any case.

11. GUGUK LANDUK (GOOD)

The total area irrigated in both the wet and dry seasons is 190 ha or 80 percent of a DIA of 236 ha. A 25 ha area on the left of BGL2 is fed by water from another system.

12. BANDAR KUOK (FAIR)

This system irrigates an area of 367 ha, three times per annum, or 70 percent of the DIA of 525 ha. The rest of the area could be irrigated but does not have a canal. The farmers tried to build a canal on this land but have not finished yet due to an accidental death.

13. GUGUK RANTAU (GOOD)

The system irrigates an area of 318 ha, three times annually, or 76 percent of the DIA of 416 ha. The remaining area consists of areas higher than the canal, which are planted with perennials, and contain settlements and a government compound. The government compound of Kabupaten Solok has taken an area of 13.6 ha which previously was padi field.

14. AIR MANYURUK (FAIR)

The total area irrigated from the system is 227 ha in the wet season, or 67 percent of the DIA of 341 ha. The remaining area is land which is higher than the canal, containing a coffee plantation and other perennials.

15. PEKAN DOLOK (GOOD)

This area is a critical area due to high sedimentation. The farmers are breaking the embankment of Belutu River to irrigate their land. The

area irrigated is 538 ha or 86 percent of the DIA of 625 ha. An area of 459 ha is watered from the breaking of the embankment, and only a 79 ha area is irrigated from the weir.

16. SISUHAR-SUHAR (GOOD)

The project irrigates an area of 509 ha or 85 percent of a DIA of 600 ha. The primary canal stream should be given special attention due to a possible landslide hazard.

17. LUMBAN GAOL (EXCELLENT)

Almost all of the area (98 percent of a DIA of 217 ha) is well irrigated, and 110 ha are irrigated from another system. This happened because the farmers in the upper system are taking more water from the stream than they need.

18. SIGOHI BUTUHA (GOOD)

The total irrigated area is 178 ha or 81 percent of the DIA of 221 ha.

19. KELAHUN PINANG (POOR)

The total irrigated area in the system is 226 ha or 43 percent of the DIA of 530 ha. Since the survey was conducted, tertiary canals have been developed and total irrigated area is reported to be larger. At the time of the survey, the non-irrigated area was composed of a settlement, coconut trees, papayas and bananas.

20. KARIU II (EXCELLENT)

The irrigated area covers 98 percent of the DIA (adjusted) of 111 ha. An area of 74 ha is irrigated from another system.

26. BIANG LOE X (EXCELLENT)

The total irrigated area in the system, in both the wet and dry seasons, is 154 ha or 91 percent of the DIA of 170 ha. The remaining area is perennial crops, settlements, dry fields and fish ponds.

27. BATANG AMPALU (POOR)

The system only irrigates 18 ha (wet season), or 9.7 percent of the DIA of 191 ha. The remaining area is rubber plantations and other perennials.

28. BIANG KEKE II (POOR)

The system irrigates a total area of 37 ha or 17 percent of the DIA of 218 ha. The problems in this system are low stream flow and permeable rocky soil. As a consequence, 83 percent of the project area remains dryfield and forest.

29. KALAMASANG (POOR)

The system irrigates an area of 120 ha or 17 percent of the DIA of 726 ha. This poor performance is caused by factors such as the condition of the land (dryfield and forest which are not tilled) small water discharge from the streams, and the limited water distribution network (the tertiary network is not yet developed).

30. BALANGBASI (POOR)

The irrigated area in this system is 69 ha or about 25 percent of the adjusted DIA of 271 ha. About 178 ha are irrigated from another irrigation system. Even though its irrigation construction is complete, only a small area can be irrigated because the right canal is not functioning. This is because the canal is too high and a large rock blocks it.

APPENDIX C. PROJECT SIZE AND PERFORMANCE

Figure 1 shows the relationship between DIA and AIA (WS). The slope of Line A shows where both variables are increasing at the same rate. At about 300 ha DIA, the points diverge. One set of points, slightly below A, ends at about 650 DIA and 550 AIA. The other set, shown as Line B, ends at nearly 1000 DIA with only 300 AIA.

It appears from these relationships that the risk of a poorly performing project increases when DIA is greater than 300 ha. This may offset any gains in economies of size that may occur.

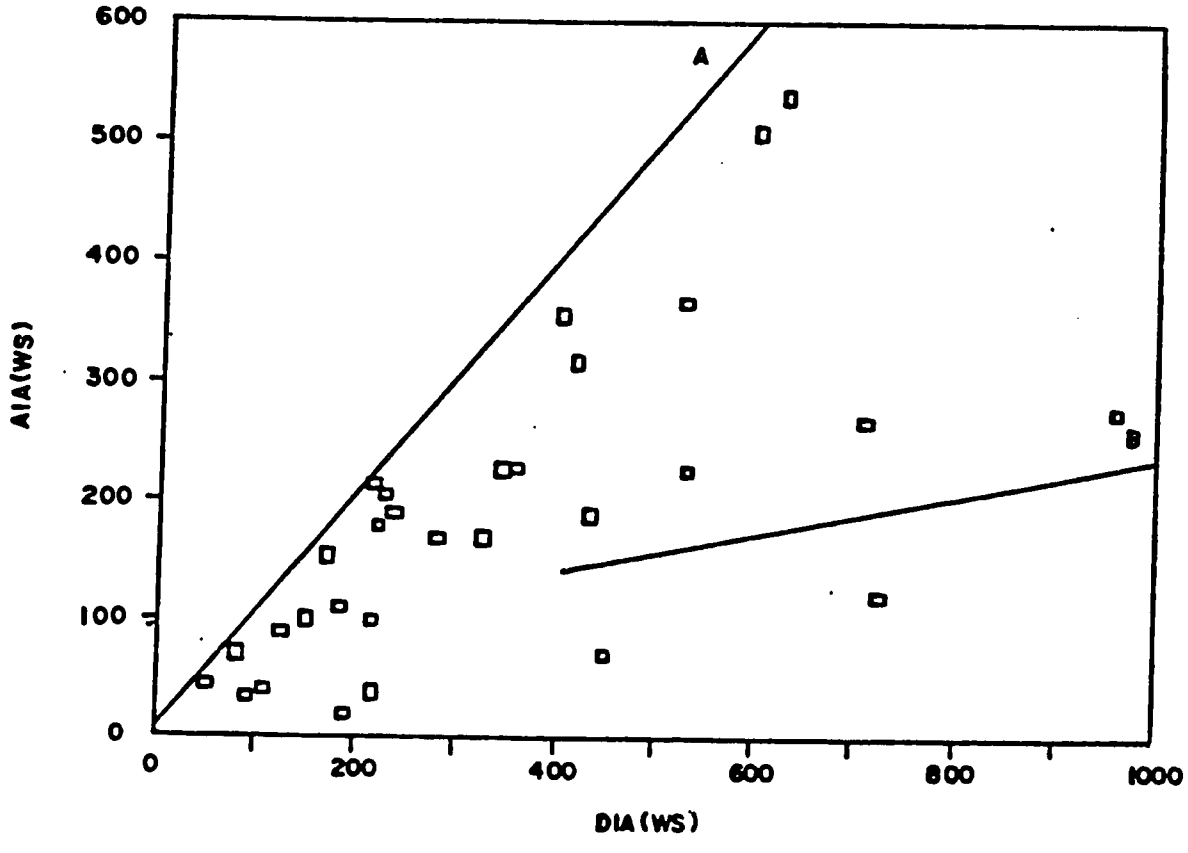

FIGURE 1. SIZE (DIA) AND PERFORMANCE (AIA(WS))

JBLICATION OF GENERAL INTEREST
VAILABLE FROM USAID/INDONESIA

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

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

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

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

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

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

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

8. The Sederhana Assessment Study for West Java, West Sumatra, North Sumatra and South Sulawesi Provinces, Indonesia, by P.T. EXSA International Co. Ltd., May 1986.