BASKETS OF STONES

Government Assistance and Development of Local Irrigation in a District of Northern Sumatera

WATER MANAGEMENT SYNTHESIS PROJECT

WMS REPORT 80

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Government Assistance and Development of Local Irrigation in a District of Northern Sumatera

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WMS Report 80

PREFACE

Just as the baskets of stones placed in the streams of Pidie represent the combined efforts of a number of people---so this Baskets of Stones has been made possible by the essential contributions of various people.

Foremost among those is Dr. Amin Aziz, Director of the Center for Agribusiness Research in Jakarta, Indonesia. Dr. Aziz, who is a native citizen of Aceh, was instrumental in the initial planning of the research, in its implementation, and in the final analysis of the data. He arranged our collaboration with government offices in Banda Aceh and Sigli, coordinated our work with Universitas Syaih Kuala, identified and supervised the research staff, worked at Cornell University on data analysis, and worked with the Governor's Office and the Head of the Bappeda to organize a seminar in Banda Aceh, at which time the preliminary findings from our study were presented and discussed. Without exaggeration, the research could not have been completed without him.

Dr. Aziz assembled a very strong research team to conduct the fieldwork and prepare the various preliminary reports. They all performed their work diligently and with serious commitment to our project---while also doing these tasks in a pleasant and lively manner. My very real thanks to Mr. Hamzah Hasan, administrative coordinator of the team, Dr. Muhammad Hakim Nyak Pha, Dr. M. Isa Sulaiman, Mr. Abdullah Yahya, and Mr. Ahmad Humam Hamid, all researchers from the Universitas Syaih Kuala.

We also wish to extend our appreciation to various government officials in the provincial capital, Banda Aceh---the office of the Governor, the Bappeda staff, and the officials of the departments of Public Works, Agriculture and Interior. Likewise, in Pidie District we were greatly assisted by the Bupati and his staff as well as officials from the district offices of Public Works, Agriculture and Interior. And the list goes on because ultimately our work required cooperation from numerous officials at the mukim and village levels as well as keujreun and individual farmers. We extend our warm thanks to them all.

In addition to our cooperation from the Government of Indonesia, we all received endorsement for our work from the USAID Mission in Jakarta. Mr. Richard Cobb, then Chief of the Agriculture and Rural Development Division was supportive of our original proposal and extremely helpful in arranging for us to make initial contacts and obtain clearance for the work.

Finally, I wish to extend my appreciation to Professor Michael Walter of the Department of Agricultural Engineering, Cornell University, for his association with me in this effort. Mike visited Indonesia twice in connection with this project, and his sensible approach to irrigation development and engineering insights made important contributions.

While all of the above were important participants in the effort, responsibility for this report and the conclusions reached are mine alone. The final drafting of the report has occurred in the few open spaces of a very busy schedule over the past few months---a few weeks on the beaches of Florida's Gulf Coast and a free day while my colleagues in the Himalayas celebrated an important Shiva festival---to name just a few. I would like to think that what I have said in the following pages would be agreed upon by all, or most, of the persons identified above. But, of this I cannot be certain and no such claim is made here.

As the reader will see in the pages that follow, I believe that the baskets of stones found in the streams of Pidie represent something strong and enduring about local irrigation in Aceh---sound irrigation institutions and appropriate irrigation facilities. Both have served Acehnese society well in the past. That is not to say, of course, that either is perfect or that no improvements are likely. Not everything about local irrigation in Pidie is as effective as it could be and changes will be needed and are underway---or planned. What I hope this research will contribute to is the creation of policies for developing local irrigation in Aceh that build on these solid achievements of the past.

Ithaca, New York
March, 1988

INTRODUCTION

Local irrigation networks built, operated and maintained for the most part by local people rather than state irrigation agencies are prevalent throughout Asia and other regions of the world.[1] State interest in these systems has waxed and waned but in recent years has been on the increase. The research discussed in this report is concerned with the nature and consequences of state assistance to such local systems. Focusing on a single administrative district in the province of Aceh in northern Sumatera, it addressed two basic questions. First, what state assistance was given to what types of local systems in Pidie district? And second, what were the consequences of this external assistance on local processes of resource mobilization.

Conceptual Issues

In the creation of state strategies for assisting the development of local irrigation, a major challenge is achieving the right mix of state and local involvement. In recent years many approaches have been based on a large and dominant role for the state's irrigation agency and an increasingly marginal position for local groups. Elsewhere I have referred to this approach as a direct investment strategy (Coward, 1986). That is, the state through one or more of its technical agencies acts

[1] In discussing local irrigation I have in mind a meaning of local consistent with that outlined by Uphoff (1986:10-14). Local irrigation systems are those whose everyday operation, and often original construction, is managed by some group such as a hamlet, neighborhood or kinship group, or a relatively self-contained residential unit (a community) or a set of communities.

directly, using its own budget and staff to design, construct, and operate irrigation facilities which are government owned.

Concomitant with these direct government investments, parallel investments have continued in the local sector---investments made by water users through a variety of local institutions such as water users associations, local government units, farmer cooperatives, etc. In some parts of Asia local irrigation serves a major portion of the overall irrigated area. For example, in Indonesia approximately 40 percent of the irrigated rice fields (*sawah*) are watered by local (sometimes called desa) systems. In South Asia, minor irrigation is an important element of the irrigated agriculture of India, Bangladesh, and parts of Pakistan. In Nepal it is estimated that nearly 80 percent of the irrigated area is served by small nongovernment systems.

In recent years many states have provided assistance for these small-scale local works. Sometimes they use a direct investment approach. In these cases, improvement of an existing small system or the construction of a new one is very much a state-controlled process. Often the works that are built, or improved, become part of the government sector which owns the facilities and is responsible for their upkeep and improvement. For example, this approach to assisting local irrigation was used in Indonesia as part of its special Sederhana Program (HIID, 1983).[2]

But there also are examples of states providing indirect assistance to local groups for small-scale irrigation---aid in the form of technical

[2]The USAID-funded Sederhana Program, run through the irrigation agency, built new small-scale irrigation systems and improved existing ones. Many of the latter were previously in the local sector. Funding levels allowed the agency to accelerate the pace of small-scale irrigation development. This program has now ended.

assistance, small grants of cash or materials, or subsidized loans. When an indirect investment strategy is used, the process is more often locally controlled. The pace of development and the priority actions to be taken, for example, are determined to some extent by the local group. Frequently, ownership of the hydraulic facilities remains with the local group. Government actions do not alienate local people from the irrigation facilities. An indirect, or community-based, investment strategy has been used in programs such as the Philippines' communal irrigation program and in Indonesia's Village Subsidy Program. In India and Nepal indirect investments are sometimes made through panchayat organizations with resources being provided, as in Nepal, through the Ministry of Panchayats and Local Development. Some studies of indirect investment strategies are discussed in detail below, but none of these are comprehensive studies of this approach that would assist one to understand the conditions under which such an approach might be appropriate and the critical steps needed to successfully implement this strategy.

A better understanding of the indirect approach is especially relevant at this time for the following reasons. First, while many governments in Asia continue to give high priority to irrigation development, the government resources, financial and human, required to implement and sustain direct irrigation investment are limited. One manifestation of this problem is the present concern with recurrent costs. The solution is not simply to shift all responsibilities and costs from the state to local groups, but rather to seek a mix of agency and local group rights and responsibilities based on a realistic understanding of the high opportunity costs of many of the state's

resources and the possibility of creating situations that induce continued, and perhaps increased, local mobilization of resources.

A second reason for concern is that the direct investment strategy has frequently resulted in irrigation systems whose performance is far below expectations. While the causes of poor performance vary, common difficulties include inappropriate agency procedures and actions as well as ineffective actions on the part of the users. The direct investment strategy, characterized by heavy state control of the investment process, seems to create an inappropriate mix of state and local rights and responsibilities. The indirect approach, in which the state attempts to support locally based actions, has the potential for structuring a more suitable balance of state and local functions.

Relatively little research has been done on the indirect investment strategy. As Kikuchi, Dozina and Hayami (1978:211) note,

> . . . few empirical explorations have been made to identify the economic and social conditions by which labor and other local resources can be effectively mobilized by village communities.

One such study, Akino's (1979) review of the development of irrigation infrastructure in Japan in the twentieth century, emphasizes the role that government subsidies and loans have played in inducing mobilization of community resources and preserving local control of irrigation facilities. The most detailed analysis of the indirect investment approach has been done by Hayami and his colleagues in their examination of assistance to the local irrigation sector in the Philippines and Indonesia.

The Philippine case is the Cavite Communal Irrigation System in Zambales Province (Kikuchi et al., 1981; Dozina et al., 1979), a 90-

hectare system owned and managed by the local village council. Following significant flood damage the village council arranged to obtain resources from several outside agencies including technical assistance, materials such as cement and steel rods and foodstuffs for those providing labor for the project. The primary resources mobilized locally were labor (more than 1,000 man-days) and the local administrative skills to plan and implement the project.

The conclusions of the authors are striking (Kikuchi et al., 1978: 225):

> It was found that government assistance facilitated the mobilization of local resources, primarily labor, on the order of 50-80% of outside assistance. In terms of social benefit and cost criteria, the irrigation project proved to be highly profitable.

In commenting on the implications of this case study, the authors draw attention to two important points. First, investments in the irrigation system in this location had high payoffs in terms of agricultural productivity. And second, the nature of the social organization in this location allowed for a relatively good distribution of project benefits across social classes.

The Indonesian study is based on the analysis of two small village irrigation systems which were assisted through the national Village Subsidy Program (Hafid and Hayami, 1979). Each village received a subsidy of US $250 which was then matched by locally mobilized resources including construction materials, labor and some payment for hiring skilled craftsmen. The authors calculate an investment inducement coefficient of 4.4 and 5.4 for the respective systems---based on the ratio of total investment (local plus external resources) divided by the government subsidy.

Hafid and Hayami conclude that these two projects were successful for the following reasons: 1) the benefits were apparent to each of the villages, 2) the projects did not involve the dislocation of people, and 3) the projects involved construction of the complete system. What the authors do not highlight is that the projects received assistance from the state in a form that allowed the local groups to manage the improvements and continue to own and control the facilities.

These case studies of the indirect investment approach suggest what might be accomplished using such strategies. However, more is needed to identify clear and persuasive policy options for two reasons: 1) the available case studies emphasize the mobilization of labor to the exclusion of other important local inputs such as knowledge and experience with the facilities of the system as well as the important resource of local administrative capacity, and 2) they do not elaborate the nature of the interaction between the state agencies and the local groups in the investment process. To come closer to that goal

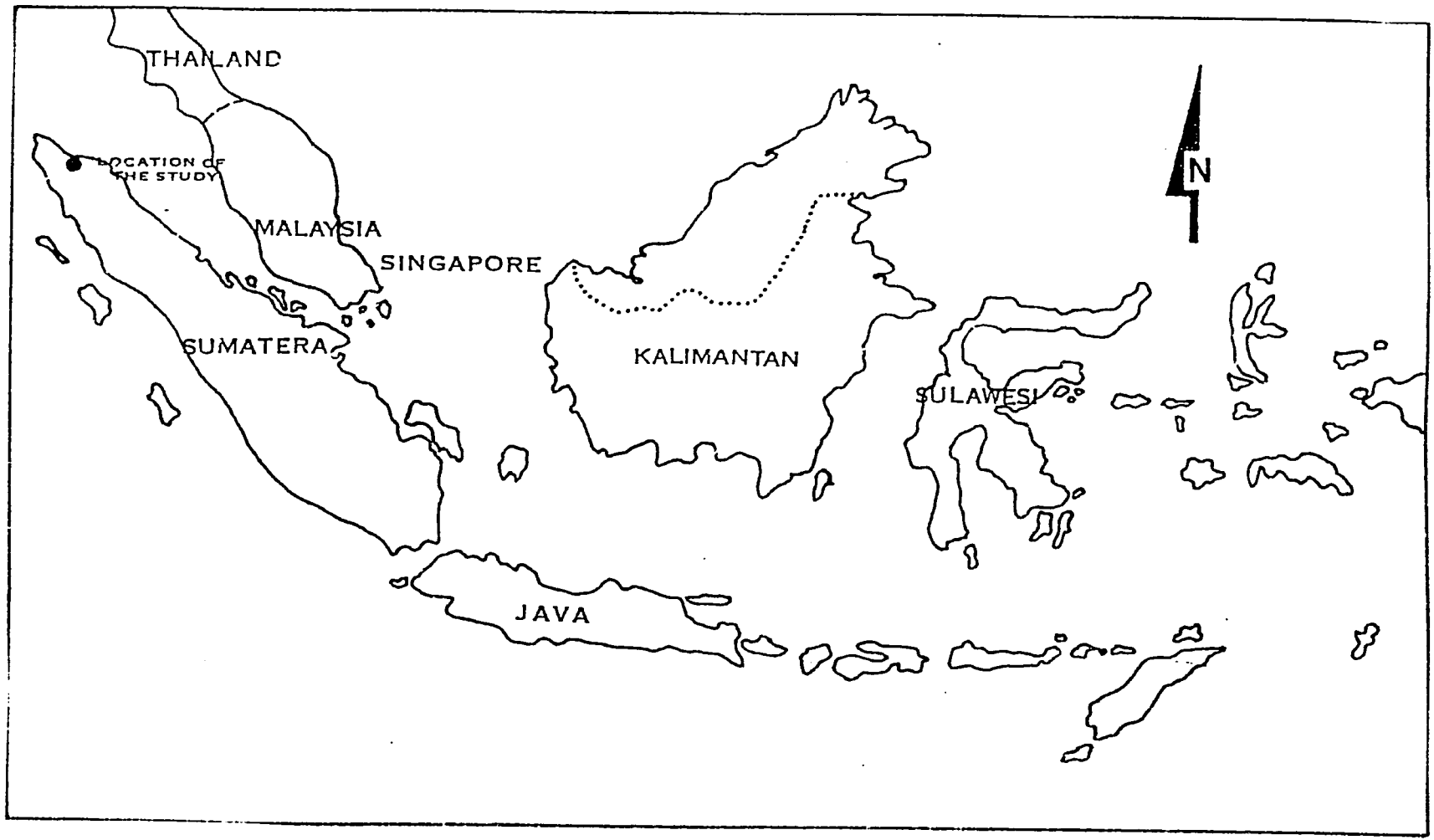
- there is need to move the analysis from a focus on a few irrigation system subprojects to analysis of a larger set of subprojects in a region or district where both indirect and direct strategies have been used, and
- there is need to broaden the analysis to focus on a wider range of locally-managed resources and to consider the nature of the state-local interactions in implementing the two strategies.

In sum, it is possible to build on these important prior studies, expanding and broadening the research strategy as noted above, for the purpose of developing a stronger research base from which to propose alternative investment policies.

The Research Approach

To investigate these issues surrounding state assistance to local irrigation, research was undertaken in the District of Pidie in the Province of Aceh, located at the extreme northern tip of the Island of Sumatera. There were several reasons for the selection of this location. Aceh is one of many provinces in Indonesia where local irrigation is a significant component of the irrigation scenario and where a variety of government programs have operated in support of the further development of this component. Also, there was some preference for working in an off-Java location since numerous irrigation studies already have been completed in Java and since it is anticipated that much of future irrigation development in Indonesia will occur on the outer islands. And third, since the work was being supported by the U.S. Agency for International Development the Jakarta staff wished to see the work implemented in a location that had relevance to AID's overall programming. The Province of Aceh had been one of the first provinces included in AID's Provincial Development Program, and AID had considerable in-depth experience working with the provincial development board (Bappeda) on a wide range of activities, including local irrigation.

In an initial visit to Aceh in February, 1986, discussions were held with staff members of Bappeda as well as the departments of Public Works and Agriculture to explain the proposed research and obtain suggestions regarding a suitable district location for the research. In those discussions there was wide agreement that the district of Pidie would be appropriate because of the importance of irrigated agriculture,



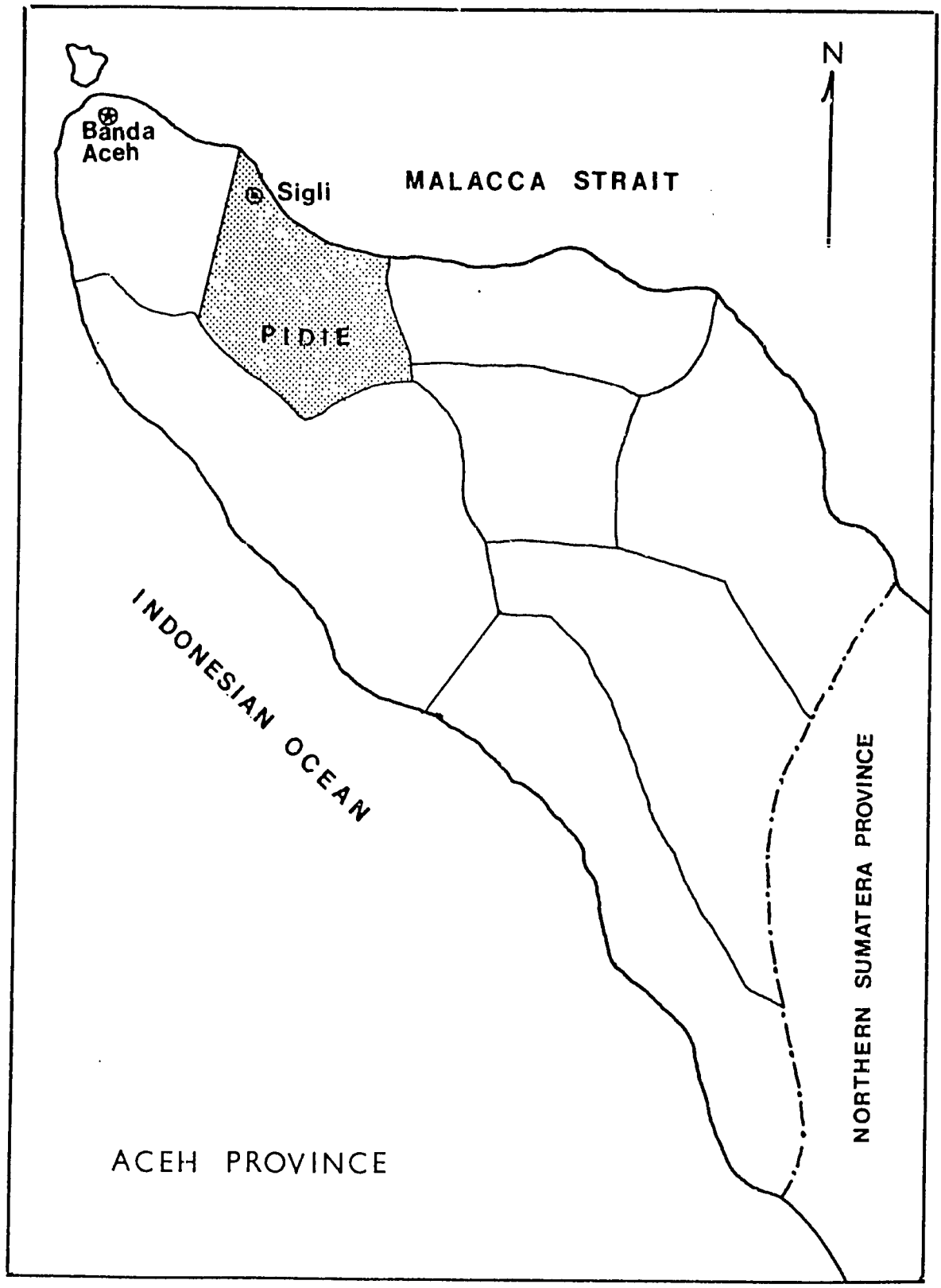
Map 1: Indonesia

the prevalence of local irrigation networks, and the variety of government assistance that had been provided to these systems.

The data collection effort in Pidie was divided into three sequential phases: an inventory, case studies, and a multi-system survey. We began with an inventory phase because there is no existing compilation of local irrigation systems in Pidie (or any other district in Aceh). Agencies such as Public Works and Agriculture tend to have information only on local systems to which they have provided assistance or which lie within an area targeted for future assistance. In developing our inventory we first sampled 12 of the 23 subdistricts (kecamatan) in Pidie. These 12 subdistricts were selected because they had the largest areas of irrigated sawah but with the additional provision that several of the subdistricts would represent the core rice-bowl area of the coastal plain and that at least two of the subdistricts would be in the hilly areas of Pidie so as to provide some representation of the ecological conditions of the district. The selected subdistricts and their estimated area irrigated by local irrigation are as follows:

Padang Tiji	3,780 hectares
Mila	2,041
Sakti	2,300
Tiro Trusel	1,507
Mutiara	2,450
Meureudu	1,750
Bandar Dua	2,300
Simpang Tiga	1,813
Tangse	1,700
Geumpang	1,115
Glumpang Tiga	1,786
Kembang Tanjung	1,100

The total estimated area served by local irrigation in these 12 kecamatan is nearly 24,000 hectares and represents approximately 75 percent of the estimated area under local irrigation in Pidie. The two hill subdistricts are Tangse and Geumpang.



Map 2: Aceh Province

Having selected these subdistricts, the next step was to develop an inventory of all of the local irrigation networks existing in each subdistrict. This was done through extensive interviews with kecamatan officials, the heads of the village clusters (imum mukim), village headmen (geusyik), and the traditional irrigation caretakers (the keujreun who are discussed in more detail below). For each local system identified, the information shown in Table 1 was collected. Collection of these data required three researchers working full time from early November through the end of December, 1986. They identified a total of 146 systems and prepared an inventory table for each of the 12 subdistricts.

Table 1. Information Gathered in the Inventory Phase

1. Name of the irrigation system
2. Location by subdistrict (kecamatan), village cluster (kemukiman) and hamlet (meunasah)
3. Estimated area irrigated in wet season
4. Estimated area irrigated in dry season
5. Estimated number of farmers served
6. Name of water source
7. Agency assistance received in past ten years

Using the data available from the inventory phase, seven irrigation systems were tentatively selected as the foci of detailed case studies. These would cover a range of ecological settings (coastal and hilly areas), types of irrigation technology (small mountain streams, swampy areas, and large coastal rivers), and forms of government assistance (including both projects undertaken by the irrigation agency and those funded through the Village Subsidy Program). The research team visited each of these seven locations and selected six sites. Summary information on these six case study locations is presented in Table 2.

Table 2. Names and Characteristics of Case Study Locations

System Name	Kecamatan	Characteristics
*Irigasi Alue Kumandeh	Tangse	Hilly; Sederhana project
Neulop Beuracan	Meureudu	No assistance
*Irigasi Blang Awe	Meureudu	Upstream coastal; Sederhana project
Neulop Amud	Glumpang Tiga	Large canal; Public Works assisted
Neulop Taka Adan	Kumbang Tanjung	Swamp; Village Subsidy funds
Leupeung Datoh	Padang Tiji	Small tank; Army assistance

*One could argue that these systems are no longer local systems having been assisted under the Sederhana program. While this is a correct observation, we have included them among our case studies so as to be able to assess the impact of such a transition. The case studies reveal that much of the action in these two systems remains locally controlled.

For each of the six case studies the following information was compiled: a sketch map of the irrigation network; background information including type of irrigation technology, crops grown, other important economic activities in the area; information on government assistance received by the system; details on the current level and form of local resource mobilization for system operation and maintenance; and information on previous levels of resource mobilization, either prior to government assistance, or if there had not been any government assistance, five years prior to 1986.

Each of the three field researchers was responsible for two case studies. This phase of the work began in late January, 1987, and was

completed by the end of April. A case study report for each of the six systems was prepared.

The final phase of data collection was a survey of 49 local irrigation systems selected from the listing developed in the earlier inventory phase. These 49 systems were selected on the basis of size, type of irrigation technology, and form of state assistance received. Basic characteristics of the sample systems are shown in Table 3.

Table 3. Characteristics of the 49 Local Systems in Survey Phase

Characteristics	# of Systems	% of Total
Size in Wet Season		
50 hectares or less	13	27
51-150 hectares	21	43
More than 150	15	30
Form of state Assistance		
None	21	43
Irrigation Agency	15	30
Other agencies	13	27

Some explanation of these categories is required. With regard to size we defined the boundaries of a system in the following two ways. Most systems were defined as the command below the diversion on the natural water source---the mountain stream, the coastal river or the swampy area. However, there is another type of local system in Pidie---the large *leung* (canal in Acehnese) network. These large leung networks are found in the coastal areas, have main canals many kilometers long, and may serve several thousands of hectares covering tens of villages. Many of these networks are local systems and are not operated by the irrigation agency. For purposes of our investigation, we considered the sub-units of these large leung networks as individual local systems.

Based on these definitions, command areas for the 49 systems ranged in size from 17 to 426 hectares in the wet season. The size categories were selected for the following reasons. First, systems of 50 hectares or less are usually viewed in Indonesia as small enough to remain in the local sector and too small to be the concern of the irrigation agency. The second and third categories are of interest because the irrigation department plans to turn over to local control all government-operated system command areas under 500 hectares. The first stage of implementing this policy will focus on turning over systems with commands of 150 hectares or less.

For our purposes we divided state assistance into two categories---assistance from the irrigation agency and assistance from "other agencies." This division reflects at least two important points. First, and most important, the irrigation agency has been much more likely to implement improvements to the main system facilities than have other agencies. Second, the irrigation agency is the only agency with professional engineering capacity. It is not unusual for a system to have received aid from more than one agency. In these cases, whenever one of the agencies involved was the irrigation agency the system was assigned to the category of irrigation agency assistance.

Among the most important programs included in the "other" category is that administered by the Department of Home Affairs (Dalam Negri) and called herein the Village Subsidy Program (formally called in Indonesian *Bantuan Pembangunan Desa* but sometimes also referred to as *Subsidi Desa* or *Inpres Desa*). Funds for the Village Subsidy Program are provided from the office of the President (Instruksi President or Inpres) with supplements from the provincial and or district governments. These funds

are provided to each village based on population size. They are to be used by the village to purchase materials and hire skilled manpower for building needed facilities and matched by contributions from the villagers in the form of materials, cash or labor. In the early years of the program (1969-74) a significant portion of these funds was used for irrigation improvements at the village level.

THE SOCIOTECHNICAL CONTEXT

Having provided an overview of our research procedures and an introduction to the local irrigation systems examined in the case study and survey phases, this section of the report will deal with two important contextual elements---the irrigation technology and operations and the irrigation institutions found in the local systems of Pidie. To understand the impact of government assistance to these local systems, we need a more detailed understanding of the irrigation technology and operations associated with these local systems. It is equally important that we discuss the nature of the local institutions that provide order for the upkeep and use of these irrigation facilities. In short, this section will provide the reader with a sense of the sociotechnical context of local irrigation in this Acehnese district.

Irrigation Technology and Operations in Pidie

Most irrigation works in Pidie use surface water as the supply (there are some systems in the hilly areas that also depend on flow from springs), and nearly all of the headworks are diversion structures (again, there are some exceptions in areas that use small tanks for some temporary storage).

The structures that divert water, at the headworks location on a river as well as at the head of secondary canals along a main canal or large leung, are called *seuneulop* in Acehnese, or *neulop* for short. Local terminology does not distinguish between neulop of different sizes or between those used for river diversions as contrasted with those built within the distribution network. In Pidie neulop is one of the most frequently heard terms when discussing irrigation. In addition to its use for multiple types of diversion structures it also can be used to refer to the entire irrigation network or system. In this sense it often is used as part of the formal name for a local system---Seuneulop Beuracan or Neulop Amud. For this discussion we will use the phrase neulop network when referring to the irrigation system and neulop when referring to a diversion structure. Neulop are made of various materials, but most commonly bamboo, stones from the riverbeds, and wooden timbers are used in some combination. On some of the large rivers in the coastal plain area, the neulop is of a particular type called *beuriyeueng*---a structure made by first weaving large cone-shaped baskets of bamboo which are then filled with stones from the riverbed---baskets of stones that are a kind of traditional gabion or crate structure. Over the years, a number of the small neulop within the distribution systems of many networks have been converted to permanent structures of concrete---either with farmer funds, state assistance, or both. In a few cases the state has replaced temporary neulop diversions on the rivers with permanent weirs---as in the Sederhana subprojects.

The canals of these local systems (called leung) are of unlined earthen construction. Typically, in addition to the main canal (called *leung inong*, literally mother canal), there are various branch or

secondary canals (called *leung sapai*, literally canal arms). The neulops, of various sizes, are generally located at each of the numerous branches of this canal network.

This combination of neulops and canal network allows for the relatively complex management and distribution of water within the system when it is required. Rotational water distribution during times of shortage is common. For example, in the network called Seuneulop Beuracan when water is scarce there is a night and day rotation along its main canal. Seuneulop Leung Tumpeun, a structure along the main canal, is recognized as the boundary between the head and tail zones. During the period of rotation, the head zone receives water from six in the morning until six in the afternoon and the tail portion for the remaining twelve hours. In the Beuracan network each secondary canal (often serving a single village) has its own rules for water distribution during the time that water is supplied to it. The secondary canals use a form of rotation based on daily, several day, or even weekly turn for the individual holdings.

Most local systems in Pidie have relatively small commands (see the discussion of size that appears in the Findings section below). However, there is a special set of local systems whose overall command is very large---covering thousands of hectares and tens of villages. We refer to these as large leung networks. These coastal plain systems, most of which are under local control, divert water from one of the several large rivers that originate in the hill areas and meander through the coastal plain to the sea. Water is conveyed to the sawah fields ultimately ending at the coast.

For example, one of our case study systems, Neulop Amud, is served by the Trueng Campli leung which uses water diverted from the Tiro River. The water is conveyed through a main canal approximately 15-20 kilometers in length. The canal passes through four subdistricts and irrigates about 2,000 hectares in over 100 hamlets. Many of these large leungs have an origin myth that features the prominent role of some special religious leader (ulama) of an earlier century who is remembered as being central in inspiring and mobilizing people to create the large leung. Siegel describes such religious mobilization by Daud Berreueh in the contemporary period (1969:61). These large leung networks are quite interesting because of the extensive commands and the large number of cultivators involved, both of which are successfully managed locally without involvement of the state's technical agencies.

The primary irrigated crop grown in Pidie is rice---though there is some production of soybeans and other non-rice crops during the dry season. Sixty-five percent of the 49 local systems surveyed in Pidie reported some dry season production---sometimes a second rice crop---in addition to main, or wet, season rice. Rice yields in Pidie have been among the highest in Indonesia. In Irigasi Blang Awe, a case study system assisted under the Sederhana program, the cropping pattern is what is called the 3-2-0 pattern. This means that in a three-year period the first two years are double-cropped in rice followed by a third year in which there is only one rice crop and in the dry season either the field is left fallow or some non-rice crop is grown.

Local Irrigation Institutions

In March 1973, the Agriculture Service of Aceh Province held a workshop on the topic of village irrigation. In that workshop they identified the local institution concerned with village irrigation operations as the *keujreun* arrangement. Actually, they called the institution *keujreun blang*. However, since the representative of this institution at the village level also is called the keujreun blang, we have modified their terminology in this report. When speaking of the overall institution we will call it simply the keujreun arrangement or institution.

In ideal terms, the keujreun institution is conceptualized as simultaneously operating at several levels of civil administration and at several levels in the irrigation network. At the lowest level, the gampong or village, the institution is represented by a man referred to as the keujreun blang who works closely with the village headman (the *geusyik*)---more on his duties below. At the next higher level of civil administration, the village cluster (*mukim*), the institution is represented by someone called the *keujreun muda* with responsibilities for irrigation activities throughout the entire mukim. These villages and mukims are aggregated into the next level of civil administration, the subdistrict (*kecamatan*), and the person responsible for irrigation matters at this level is called the *keujreun syik*. He is seen as a staff member of the *camat*---the head of the kecamatan. It also is possible to have someone responsible for the coordination of a large irrigation network that covers more than one kecamatan, and he may be referred to as the *manteri leung*, literally, canal head (Dinas Pertian Rakyat, 1973).

In this way the keujreun arrangement, while specific to irrigation matters, operates as an element of the civil administration. Also, it is sufficiently flexible to cover both administrative and hydraulic boundaries. For example, at the village level several situations may exist. There may be facilities of an irrigation network that serve this village as well as others. If so, typically there will be a keujreun blang for each village served by the network. And, if that network covers a group of villages, all of which fall within a single mukim, then the activities of the several keujreun blang can be coordinated by a keujreun muda (or mukim-level keujreun). Hamid writes that the keujreun blang is selected by the farmers of the village area with the approval of the village head (1987:39). Usually the keujreun at the higher levels are appointed by the administrative heads of those units from among the existing keujreun blang.

While working closely with the various heads of the civil administrative units, the keujreun also are accountable to the water users since it is from them that they receive payments for their activities and not from the government. These payments are called *beuheuek bruek umong*. The literal meaning of this phrase if the "half of a coconut shell (bruek) share (beuheuek) of unmilled rice to be paid by each rice field plot (umong)." In Neulop Amud, one of our case study locations discussed below, farmers make an annual payment to the keujreun blang of 12 kilograms of rice for each quarter hectare of sawah that they cultivate (this quarter hectare unit is a traditional unit of measurement called a *naleh*). Payments to the keujreun blang can become problematic if farmers perceive that his services are ineffective or unnecessary. In another of our case study locations, Irigasi Blang Awe, where the

irrigation agency had made major improvements in the main system facilities and placed a staff member to perform some O&M activities, farmers are increasingly reluctant to continue payments to the keujreun. The implication is that with the improved water supply in the main system and decrease in some maintenance work, there is less need for the activities of the keujreun.

In Seuneulop Beuracan, a network that has received little state assistance, we found the duties of the keujreun blang to include a wide range of activities---coordinating canal cleaning and system repairs, distributing water within the village lands, involvement in the various irrigation and rice ceremonies (*khanduri*) and settling minor disputes among the irrigators.

This range of reported duties is consistent with those detailed in an ordinance issued by the Head of Pidie District, the Bupati, in 1973. This ordinance, which deals with the organization of rice production activities, includes an extended discussion of the keujreun institution. In it, the stated roles of the keujreun blang are as follows:

1. supervision of the work of repairing the facilities, including the management of the collective work groups of the farmers,
2. managing the distribution of water,
3. settling disagreements among farmers regarding water distribution, and
4. supervising and controlling timing of the planting of the rice nurseries and the subsequent transplanting to the fields.

We have been unable to uncover any definitive materials regarding the history of the keujreun arrangement. Hamid's (1987) suggestion that the institution of keujreun was a creation of the *uleebalangs*---the territorial chieftains who were important in pre-Dutch Acehnese society and became even more so in the subsequent colonial administration---is

plausible though without specific documentation. This supposition is consistent with Siegel's point that "Each year the uleebalang built stone obstructions at the foot of the hills to divert a portion of the river waters into irrigation channels" (1969:24). While Siegel's statement appears to attribute the work to the uleebalangs, it is clear that the actual labor would have been provided by the cultivators---perhaps under the everyday supervision of keujreun.

But not all irrigation systems in Pidie have the keujreun arrangement. Our survey indicated that 65 percent of these systems supported the keujreun institution; the rest did not. There are two situations in which the keujreun institution is absent. One is in very small systems where only a few farmers are involved. These farmers simply coordinate their irrigation operation and upkeep activities informally. The other situation is that in which numerous water users are involved, but coordination of operations and maintenance is done by the local government authorities without the aid of the keujreun. For example, in Leupeung Datoh there is no keujreun blang; irrigation activities are the direct responsibility of the village headmen, imum mukim and camat---all of whom have been active in seeking external support for system development as well as mobilizing local resources for operations, upkeep, and development. Elsewhere, the keujreun blang operate at the village level, but supervision at higher administrative levels is provided directly by the imum mukim or camat without the aid of keujreun.

Thus, it appears that the neulop network is seen locally as one element in the larger wet-rice production complex. That larger complex seems intended to provide an overlay of event scheduling that both

provides the necessary prerequisites for and requires related actions from the owners or cultivators of privately held sawah. The physical facilities of the neulop network are kept, or put in order, and the activities of the neulop network users synchronized, bounded and directed through the combined efforts of the various civil administrative authorities and their associated keujreun. As one element in this wet-rice complex, neulop network activities, like other activities associated with wet-rice production, have a spiritual dimension. Both the timing of collective activities, such as neulop repair and canal cleaning and their completion, are celebrated through ritual events known as khanduri.

Traditionally, neulop networks appear not as facilities owned by some group of co-proprietors but as public infrastructure, public utilities as it were, whose maintenance and operation lies jointly with the civil administrators, irrigation caretakers, religious leaders, and the related users. Initial decisions regarding their annual refurbishing and use are made in a forum organized at the subdistrict (kecamatan) level by the camat.

The ordering of a particular season begins with a formal meeting called by the subdistrict head (camat) and attended by the various civil authorities in that kecamatan and their associated keujreun. In this meeting, discussions of the coming agricultural season are held, and dates are set for key activities such as repairing and cleaning the neulop networks, initiating land preparation activities and so on.

Hamid (1987:73-74) provides some detail on the subdistrict meeting held in Kecamatan Simpang Tiga:

> As in other kecamatan, the regular annual meeting in Kecamatan Simpang Tiga is held before the end of September. This meeting produces the rice-growing activities calendar which guides the agricultural

> activities of villagers in the kecamatan. Once the calendar is decided on it is the duty of the keusyik and the imum mukim to implement the decision. The calendar is generally directed toward uniformity of farming activities in the kecamatan in accordance with the district planning of rice-growing activities. Aside from producing the rice-growing calendar the meeting appoints several kecamatan officials and kemukiman representatives to sit on the *Panita Khanduri Teungku Syik di Pasi* (a committee to manage this important ceremony). At the same time the meeting will calculate the amount of money needed for the khanduri (ceremony) and assign a given amount for each kemukiman to be collected from farmers through the keusyik.

Thus, the neulop network is highly intertwined with matters of civic and spiritual order as well as agronomic practice. Its state of readiness and smooth operation are both necessary for and a reflection of larger order in the realms of governance and culture. The effectiveness of the neulop network is dependent upon the synchronized individual behavior of multiple users as well as their timely collective action---a pulsating rhythm of aggregating and disaggregating in which people sometimes come together to act jointly while at other times acting independently but in coordination.

We see, then, that the order needed for effective wet-rice production and neulop network operation is socially constructed by the Acehnese of Pidie. The Acehnese have a saying that irrigated agriculture requires men to act like brothers. However, unlike other regions of Southeast Asia in which the required social solidarity is achieved through the formation of a specialized irrigator's group (for example, the subak of Bali or the zangjera of Ilocos Norte), in Aceh order is accomplished through the actions of the civil administration (the camat, the imum mukim, the geusyik) and the specialized irrigation institution called keujreun---an institutional arrangement with accountability to

both the civil administration and the water users. In short, irrigation order can be seen as one element of general public order.

In brief, the salient points regarding the institutional arrangements for local irrigation in Pidie are as follows. First, the basic element is the local administration---the "headmen" at the various administrative levels of village, village cluster and subdistrict. Occasionally, even the head of the district, the Bupati, is involved. In many, but not all, cases these administrative officials are assisted by keujreun---local irrigation caretakers who aid these officials by assuming responsibility for everyday irrigation activities within the boundaries of the respective administrative unit. In some locations these keujreun exist at some but not all administrative levels---frequently at the village but not higher levels.

In Pidie, then, there is an absence of what have come to be called water user associations. While the keujreun do receive contributions from the water users, they are not the staff of some membership-based organization formed by the farmers. Rather, they are intermediate between government and farmers. On the one hand, the keujreun are arms of the local government officials who derive their authority to direct farmer activities from their association with local government authorities. On the other hand, local government has no budget with which to pay the keujreun. Thus they depend upon the farmers to provide support for their services. In this way the keujreun also are accountable to the cultivators.

THE RESEARCH FINDINGS

State Assistance to Local Irrigation: Extent and Form

Of the 49 local systems covered through the research survey 57 percent had received some form of state assistance. The other 43 percent were operating entirely with resources obtained locally. Of those receiving state aid, 30 percent received assistance from the irrigation agency (Public Works, abbreviated PU in Indonesian) and 27 percent from other agencies (such as the Ministry of Agriculture and the Ministry of Interior). This information is presented in Table 3 (page 12) which shows that state assistance has not gone to all systems. Of the state-assisted systems, approximately equal numbers did and did not receive aid from the irrigation agency.

Local irrigation systems include commands of varying sizes, and a useful question to examine is the relationship between size and state assistance. As noted above, the three size categories shown in Table 3 have relevance to both established and emerging public policies in Indonesia. The data show that of the sampled systems with commands of less than 150 hectares about one-half received no assistance. Of the half that did receive state assistance, nearly an equal proportion received aid from the irrigation agency as from other agencies. The irrigation agency did very little with the smallest systems---only one of the thirteen surveyed systems with less than 50 hectares of command received such assistance but 38 percent of these very small systems did receive assistance from other agencies.. Most state assistance was directed to systems with commands of more than 150 hectares: 60 percent

of the systems assisted by the irrigation agency and 62 percent of those assisted by the other agencies.

To get a detailed understanding of the forms of assistance that were provided to these local systems we turn our attention to selected information gathered in several of the case studies:

1. Seuneulop Beuracan irrigates approximately 400 hectares of land located in villages in two mukim (village clusters) in the subdistrict of Meureudu. It has a main canal approximately 7 kilometers in length which carries water from a diversion on the Beuracan River. Seuneulop Beuracan has one keujreun muda who is responsible for the entire Beuracan network and a number of keujreun blang, one for each of the villages served by the system. These keujreun, along with the village headmen and the two mukim heads, work with the farmers of the system to mobilize labor, cash, and other items needed to repair and operate both the main and secondary system facilities.

The diversion on the river is made of local and purchased materials---gabion wire as well as bamboo and stones. No state assistance has been received for the construction or annual repair of this structure. Along the main canal is a series of neulop used to turn out water from the main canal to secondary canals, or in some cases, to fields immediately adjacent to the main canal. Some of these structures have been made permanent with concrete. In most instances funds for construction were collected from among the farmers using that particular structure. In other instances, either the irrigation agency or the Village Subsidy Program provided some aid.

For example, one of the diversion structures along the main canal, Seuneulop Meunasah Kulam, was made a permanent concrete structure in

1976. Funds in the amount of Rp 350,000 were provided through the Village Subsidy Program. In addition, farmers provided a total of approximately Rp 950,000 which was collected by having farmers contribute 60 kilograms of unmilled rice for each naleh of sawah that they cultivate. Farmers also contributed 100 man-days of labor by providing ten laborers for each of ten days.

2. Neulop Amud is one of nine local irrigation networks receiving its water from the large Trueng Campli leung which diverts water from the Tiro River. The Trueng Campli is a very old network, reportedly constructed in the seventeenth century. The diversion on the Tiro remains a impermanent one and is the traditional beuriyeueng type (see page 16).

The main structure of Neulop Amud diverts water from the Trueng Campli main canal into the Blang Raya canal, the primary canal for the Neulop Amud network, which irrigates approximately 322 hectares. Along the Blang Raya there are ten structures that divert water into smaller branch canals. The total command area of this neulop network falls into three different village clusters (mukim) covering thirteen different villages. The operation and maintenance of the Neulop Amud network depends on the actions of the three mukim heads, the various village headmen and the keujreun staff---one for each village plus a watchman assigned to look after the main neulop on the Trueng Campli canal.

The present Neulop Amud main diversion structure was built under the direction of the Camat of Glumpang Tiga who supervised the collection of funds and labor from the water users in 1958. In doing this he delegated responsibilities to the concerned imum mukim and geusyik. At that time each farmer was to contribute 42 kilograms of unmilled rice for

each naleh of sawah (one-fourth hectare) as well as labor for construction work. Reportedly, about 500 people worked for one week, along with local stonemasons, to complete the work. The Public Works office in Pidie provided technical assistance in the form of a design for the structure.

Improvements also have been made in the smaller neulop along the Blang Raya canal. The first of these to be made permanent was built in 1964 and the last in 1981. Labor and other contributions for these improvements were coordinated by the various imum mukim and village headmen and the associated keujreun. Procedures for mobilizing these resources were the same as those used for improvements to the main structure, the Neulop Amud.

Starting in the mid-1970s the irrigation agency began providing construction assistance to this network. In 1974-75, it allocated more than Rp 3 million to build a concrete spillway in the Trueng Campli main canal just downstream from the main Neulop Amud diversion structure. In 1979-80, the irrigation agency spent Rp 3.5 million to construct a control gate at the head of the Blang Raya canal. There were a number of problems with this headgate from the beginning---a poor location was selected, it is a difficult site to which to move materials, and there were some disruptions due to political instability. But the basic problem was the elevation of the headgate relative to the level of the Trueng Campli canal. To effectively operate the headgate one had to raise the level of water in the main canal above that normally achieved by the Neulop Amud structure. As a result, the headgate only functioned for about two years.

3. Irigasi Alue Kumandeh is a system irrigating nearly 150 hectares in the hilly subdistrict of Tangse. Water for this system is diverted from the Peunalom River. The neulop network that preceded Irigasi Alue Kumandeh was originally constructed by the farmers in the early part of the twentieth century---about 1915. The work was done by the local people and traditional technologies such as the beuriyeueng---baskets of stones---were used.

In 1976, as a result of meetings held in the two villages served by Alue Kumandeh, the imum mukim sent a request to the Camat asking for Public Works assistance for the system. Initial work on constructing a permanent weir to replace the beuriyeueng was completed in 1979 and additional improvements were made in 1982. Also, in 1982, improvements were made in the first 1.8 kilometers of the main canal including the installation of three permanent check weirs replacing temporary neulop. These construction activities were implemented by three different private contractors.

The Alue Kumandeh improvements were part of the irrigation agency's former Sederhana program. During the planning and construction of this project farmers were not involved at all. Following construction, the irrigation agency provided a local staff member to operate the headgate at the site of the permanent weir and to do some cleaning and minor repairs on the main canal. Since completion of these new facilities there never has been any formal turnover of the system to the farmers, and farmers interpret this to mean that the facilities continue to belong to the government (merupakan milik pemerintah).

These three cases depict a range of forms of state assistance to the local irrigation networks of Pidie. The last case, Alue Kumandeh,

illustrates a strategy in which a previously local system is converted into a state operated and maintained one. In this case, the traditional main system facilities were replaced by a permanent main weir, and changes were made in the first section of the main canal. Responsibility for the operation and maintenance of these main system facilities has been assumed by the irrigation agency. State assistance to both Neulop Beuracan and Neulop Amud has been quite different. In the case of Amud, even though some changes were made in the main system, the concrete spillway and the headgate, responsibility for all routine operation and maintenance has remained with the local authorities. In Beuracan, assistance has been limited to improvement of small structures within the distribution network and management of the system has continued to be a local responsibility.

State Assistance and Local Resource Mobilization

In this section we want to explore the impact that state assistance may have had on local resource mobilization. Does the former complement or replace the latter? To begin this discussion we will review the various ways in which users contribute to system development, operation and maintenance.

Users frequently contribute cash-in-kind, labor and/or materials to upgrade existing facilities. Our case studies revealed many instances in which farmers covered the costs of converting impermanent check structures into concrete ones or added local resources to state resources to accomplish this purpose. Farmers regularly contribute labor and materials for the routine cleaning and repair of both main system (the main diversion, if required, and the main canal) and secondary-level

facilities. Moreover, the costs of system operations are borne by the users through their support for two activities: the work of the various keujreun and the several khanduri ceremonies which are essential for operational coordination. Recall also that this set of activities is put in motion and given order not only through the user-supported keujreun but also through the local administration officials at several levels---most significantly the geusyik (hamlet head), the imum mukim (village cluster head), and the camat (kecamatan head).

What are the possible impacts of state assistance on the incentives for local people to continue this significant resource mobilization? To assess these, we will first turn to data from the survey of 49 local systems and subsequently to the case studies.

One impact that state assistance could have on local systems would be to reduce support for the services of the keujreun---something for which farmers pay directly. As Table 4 shows, 65 percent of all systems surveyed report the presence of keujreun. Of the systems that have received no state assistance, 62 percent report having the keujreun while 68 percent of systems with some state assistance report keujreun presence.

Even though systems assisted by the irrigation agency sometimes have a staff member of that agency assigned to work with main system facilities, 73 percent of these systems have the keujreun, whereas 62 percent of the systems with assistance from other agencies have keujreun. This same pattern holds if one eliminates the smallest category of systems---those with commands of less than 50 hectares---suggesting that size does not confound the relationship. This indicates that, in general, state assistance has been compatible with the continuation of

the important local irrigation institution called keujreun and is not correlated with its demise.

Table 4. Distribution of Systems with Keujreun Institution, by Size and Form of Assistance.

Size of System (ha.)	Form of Assistance						Total	
	None		Irrigation Agency		Other Agencies			
	No.	% of 21	No.	% of 15	No.	% of 13	No.	% of 49
Total	13	62	11	73	8	62	32	65
50 or less	4		0		3		7	
51-150	7		5		2		14	
More than 50	2		6		3		11	

We also examined patterns of labor mobilization in local systems with and without state assistance. Interpretation of these data requires some degree of caution, since a reduction in labor mobilization following state assistance can have a least two explanations: improvements can reduce the need for local resource mobilization, as when an impermanent weir is made permanent; or, second, state involvement can change user's interests in and incentives for continued local resource mobilization. By combining the survey data and the case study findings, we believe that we can offer plausible interpretations and distinguish between these two situations.

Table 5 shows the relationship between state assistance and labor contributions for main system repair and maintenance. Note that the amount of labor reported is in terms of "man-days per hectare in the wet-season of 1986."[3] Nearly 70 percent of the systems mobilized two days or

[3]Cultural norms in Pidie dictate that only men provide labor for irrigation. Female heads of households are expected to find male substitutes (family or hired labor) or to provide other services such as food preparation.

less of labor for main system activities and only 22 percent of the systems mobilized more than three days. If assisted systems are compared with unassisted ones the difference is large: 80 percent of the assisted systems mobilized two days or less while only 52 percent of the unassisted systems were in this category. Two-thirds of the systems mobilizing more than two days of labor were those that have not received state assistance. If we assume that the amount of labor mobilized is the amount that is required we can suggest that state assistance reduces the amount of labor needed for main system repair and maintenance.

Table 5. Distribution of Systems by Average Labor Contributions to Main System Repair and Maintenance and Form of Assistance.

Man-days per hectare (wet-season, 1986)	Form of Assistance						Total	
	None		Irrigation Agency		Other Agencies			
	No.	% of 21	No.	% of 12	No.	% of 13	No.	% of 46
Less than 1.0	0	0	4	33	5	39	9	20
1.1 to 2.0	11	52	5	42	6	46	22	48
2.1 to 3.0	3	14	2	17	0	0	5	11
More than 3.0	7	33	1	8	2	15	10	22

We find a similar pattern for labor contributions for total system repair and maintenance---both main and secondary system facilities (see Table 6). Of those that provided more than three days of labor, 55 percent were nonassisted and 45 percent had received some state aid. This smaller difference between the assisted and nonassisted systems in labor contributions for total system repair and maintenance suggests that state assistance has a greater impact on labor savings at the main system rather than at the level of the secondary system. This result is very plausible when we consider the large amounts of labor required for repairing the temporary main diversions both at the start of the season

as well as during the rainy-season cropping period when high discharges in the streams and rivers may damage these facilities.

Table 6. Distribution of Systems by Average Labor Contributions to Total System Repair and Maintenance and Form of Assistance.

Man-days per hectare (wet-season, 1986)	Form of Assistance						Total	
	None		Irrigation Agency		Other Agencies			
	No.	% of 21	No.	% of 14	No.	% of 13	No.	% of 48
Less than 2.0	2	9	6	43	4	31	12	25
2.1 to 3.0	3	14	2	14	2	15	7	15
3.1 to 5.0	9	43	5	36	6	46	20	42
More than 5.0	7	33	1	7	1	8	9	18

Table 7 shows changes in levels of labor mobilization for repair and maintenance of the main system. For systems that have received state assistance, the change refers to the periods before and after that assistance. For those systems that have not received assistance change is measured for the period 1981-1986. Many systems (34 percent) experienced no change. More than half of the systems in this category did not receive aid, but nearly one-third had received assistance from agencies other than the irrigation agency (not surprising since the assistance of these agencies rarely deals with improvements in the main system). A second important point to note is that levels of labor mobilization declined in 52 percent of systems without state assistance. This could be interpreted as evidence of a decline in local responsibility for operation and maintenance. However, our case study materials suggest that it is more plausible to view this decrease as reflecting self-investment in the development of these systems. A somewhat higher proportion of the state-assisted systems---65 percent---

experienced a decline in labor mobilization. A larger proportion of these were assisted by the irrigation agency as compared to other agencies (about 60 percent and 40 percent, respectively).

Table 7. Distribution of Systems by Change in Average Labor Contributions to Total System Repair and Maintenance by Form of Assistance.

Change in Man-days per hectare	Form of Assistance						Total	
	None		Irrigation Agency		Other Agencies			
	No.	% of 21	No.	% of 13	No.	% of 13	No.	% of 47
Increase	1	5	1	8	1	8	3	6
No change	9	43	2	15	5	38	16	34
Decrease of								
Less than 0.5	2	10	4	31	3	23	9	19
0.51-2.0	5	24	3	23	1	8	9	19
More than 2.0	4	18	3	23	3	23	10	21

Finally, our survey data also indicate that farmer support of the khanduri ceremonies is widespread: we found no systems that reported not having these activities. Thus, local resource mobilization for this traditional activity has been maintained whether or not the system received state assistance.

In brief, the survey data present considerable evidence that state assistance has not had a negative impact on local resource mobilization, although they suggest that state assistance, especially for main system facilities, has reduced the need for labor contributions. With or without state assistance, all systems support the khanduri ceremonies, most systems support the keujreun and all systems mobilize the labor required for the repair and maintenance of both their main and secondary system facilities. Significantly, many systems, both assisted and not

assisted, have been able to reduce the amount of labor required as a result of investments, local, state, or both, to improve the facilities.

We will now turn our attention to data from the case studies to further understand this matter of state assistance and local mobilization. The case of Irigasi Alue Kumandeh represents the most intense involvement of the irrigation agency in a local system. Prior to the Sederhana project, all materials and labor required to operate and maintain this neulop network were provided by the water users under the direction of the headmen from the two concerned villages. Estimates of the labor required when the diversion was only a temporary structure are as follows:

Rebuilding the diversion	150 men for 3 days
Six Repairs to the diversion during the rainy season	30 men for 6 days
Canal cleaning	150 men for 5 days

This is a total of 1,300 man-days of labor or approximately 8.8 man-days of labor per hectare---quite high based on data collected in our survey of 49 systems. It was this situation that prompted local people to ask for state assistance. Prior to irrigation agency involvement, farmers also made contributions for three ceremonies held during the crop season. Farmer contributions for these costs was averaged about Rp 1,400. One of these ceremonies was conducted after the repair and cleaning of the main system facilities had been completed and was held at the site of the main neulop. The other two ceremonies, one at the start of the season and the other at the time of harvest, were held at the kecamatan level jointly with cultivators from other parts of the subdistrict.

Following the Sederhana project, farmers have had to mobilize less labor for system repair and maintenance. They do continue to mobilize labor for cleaning both the main and secondary canals. They report that this work requires about 165 persons working for three days---or a total of 495 man days. Thus, the number of man-days per hectare has been dramatically reduced to a present level of approximately 3.3, much more like the norm found in our survey. Contributions for the ceremonies continue as before. Irigasi Alue Kumandeh does not presently have a keujreun and apparently also did not before the irrigation project was completed.

In Neulop Beuracan assistance from the state has been much less comprehensive and has not touched the main system. The result is that there has been little change in resource mobilization. Data collected in Beuracan allow us to make the following estimates of labor and other contributions to operation and maintenance:

- Per farmer costs include approximately four days for gathering needed materials and repairing the main weir,
- Additional labor for cleaning the secondary canals calculated at approximately 20 meters of canal for each hectare of land irrigated,
- Payments for the various rice ceremonies estimated at a little more than Rp 50,000 per hectare, and
- Payment to the keujreun estimated at Rp 3,000 per hectare.

This amounts to a total per hectare cost of approximately Rp 92,600 (at the current exchange rate this is about US $56).

Neulop Amud is one of eleven local networks served by the large Trueng Campli system. Thus, the farmers of Amud contribute both to the operation and maintenance of the Neulop Amud system as well as the repair and operation of the main diversion and main canal of Trueng Campli.

Trueng Campli continues to depend on a temporary diversion structure on the Tiro River. Repair of this temporary diversion is coordinated by the Camat of Glumpang Tiga. Fifty-five villages from this kecamatan as well as several villages from two neighboring kecamatans are involved in the work. In 1986, contributions for this work included one week of labor per farmer for repairing the river structure and cleaning the main canals. In addition, farmers made cash contributions to cover the costs of hiring a bulldozer to assist with the work at the river diversion.

Within the Neulop Amud network farmers contribute to the maintenance and repair of the facilities at two levels: the main neulop on the Trueng Campli canal and the main canal served by it, the Blang Raya, and second, the particular structures along the Blang Raya canal and the smaller canals branching from it that serve their own fields. Usually just one day of work is required for the initial refurbishing of Neulop Amud and the Blang Raya canal. Often, this needs to be done twice more during the season, requiring a total of three days of labor. Cleaning the small canals that branch from the Blang Raya requires at most an additional day of work. In Neulop Amud four ceremonies are held during the main agricultural season, and farmers contribute the funds needed to perform them. Payment of the keujreun and the watchman for the main neulop is assessed at the level of 12 liters of unmilled rice for each one-fourth hectare (naleh) of sawah cultivated.

What we see from these three cases is that only in Irigasi Alue Kumandeh did irrigation agency assistance make changes in the main system facilities. And only in this system has there been a significant decrease in local resource mobilization, where the main diversion structure has been made permanent and state responsibility for certain

main system work has replaced local resources. But even in Alue Kumandeh farmers continue to make important resource contributions for a variety of operation and maintenance costs. In the other two systems, Beuracan and Neulop Amud, state assistance has not negatively influenced the mobilization of resources from the farmers. Significant contributions continue to flow from these users for a variety of costs including support of the keujreun, the rice ceremonies, and the labor and materials for repairs and refurbishing.

SUMMARY AND CONCLUSIONS

Local Irrigation and State Assistance in Pidie

Our research findings produce a positive overall picture of local irrigation in Pidie. These local systems function in the diverse ecological settings of the district---the hill areas, the fertile coastal zone, and even the low-lying swampy areas. In all of these locations, facilities are not only maintained, but also improved with locally mobilized resources. Leadership for the mobilization of these resources and for the operation of the systems, including the sometimes complex rotation of water supplies, is provided through the government officials who frequently are assisted by keujreuns functioning at various levels of the administrative hierarchy. These irrigation activities are punctuated with a special rhythm and given cultural meaning and order through the myriad ritual ceremonies (khanduri) that occur at the subdistrict, neulop network, and sometimes, individual field level. While farmer involvement in the operation and maintenance of these irrigation works is considerable, it is not accurate to label them farmer-managed systems. More to the mark would be the label "locally-managed," since it is the local authorities, sometimes with assistance from special irrigation caretakers (keujreun) who perform these functions.

State assistance to local irrigation in Pidie has been widespread. Nearly six out of every ten local systems in our survey of 49 systems had received some form of state assistance. All six . our case study locations had received state aid (although we originally thought that at least one had not). With a few important exceptions, this state assistance has served to complement rather than demobilize local

resources. In our case studies we found two exceptions to this general pattern---the two systems aided as part of the irrigation agency's earlier Sederhana Program. In these cases, extensive changes in the irrigation infrastructure, placement of irrigation staff in the systems to perform certain O&M functions, and the lack of an explicit turnover of the new facilities to the local authorities have combined to leave farmers feeling that the system (or significant parts of it) are no longer their responsibility or under their control. This has led to some undesirable reduction in local involvement or signs of such, as in Irigasi Blang Awe where some farmers are now less enthusiastic about continuing to support the keujreun.

But these few exceptions are overshadowed by the counter-finding that resource mobilization continues to be significant even when state assistance has been provided. Our case studies revealed the frequency with which resources supplied by the state are combined with local resources for the purpose of improving existing structures and canal networks. For example, in Neulop Taka Adan, where water from a swampy area is used for irrigation, the Camat in the budget year 1980-81, combined the Village Subsidy funds from ten different villages to purchase materials for improving the dike used to divert water from the swamp. Supplementing this state assistance was labor that farmers provided for construction. Even in the two Sederhana projects discussed above, farmers continue to assume responsibility for maintaining the main canal. They are fully involved in the operation and maintenance of all the secondary level structures and canals. Other evidence was derived from the survey findings. To illustrate, state-assisted systems are as,

or more, likely to have the traditional keujreun institution as are systems that have not been aided.

In Pidie the local administrative responsibility for local irrigation provides a robustness that enables it to withstand, in fact to co-opt, the state's intrusions. This is especially true for the Village Subsidy funds which are administered by the same authorities who are deeply involved in local irrigation---geusyik, imum mukim and camats.

The Pidie data also allow conclusions regarding direct and indirect investment approaches. We view the systems In Pidie assisted under the Sederhana program as cases of direct investment and other forms of assistance as indirect investment. The strength of the indirect approach as implemented in Pidie is that it leaves in place and complements local resource mobilization and customary leadership. The weakness appears to be that indirect investment in Pidie has done little to improve the water supply to a particular system or to reduce needed labor and other contributions to repair the main diversion structure. Nearly all indirect investment has been used below the headworks (an exception being Neulop Taka Adan) to rebuild turnout structures or improve the condition of canals. While this may improve the distribution of water within the system does not enhance the acquisition of water for the system.

Direct investment approaches as they have been implemented in Pidie have almost the reverse characteristics. Their strength is that they typically do improve the system's water supply---as in Irigasi Blang Awe. While this is a positive outcome, two cautions need to be raised. One is that there are a surprising number of instances in which technical difficulties are encountered in either designing or constructing these facilities. For example, the weir built in Irigasi Alue Kumandeh

operates only when farmers build temporary obstructions in the riverbed to direct water to the permanent wei . Second, it may be that these permanent weirs, while directing more water to the assisted system, reduce the amount available to other systems on the same water course. This may not be a major problem so long as the state assists a limited number of networks on a particular stream, but it could become a problem should this strategy be continued. The troublesome outcome of the direct approach, as implemented in Pidie, is that to a limited extent it erodes, or at least fails to support, customary leadership and demobilizes local resources.

What seems highly feasible and desirable is a policy and associated procedures for combining the strong features of these two approaches. For example, the irrigation agency could be encouraged to focus its attention on the improvement of headwork facilities, where needed, such as permanent weirs and headgates (keeping in mind the two cautions discussed above). Whenever possible, the actual operation of these new facilities would be left to local control. Or, if that were not possible, an agency staff person would be assigned responsibility limited to the operation and repair of those headwork facilities and would not become involved in downstream operation and maintenance. To complement these activities, some subsidized assistance, either through the irrigation agency or some other department, could be provided to the local authorities for incremental upgrading of the within-system facilities such as improved turnout structures or canal improvements. These subsidies would be under the control of the local authorities and complemented by locally mobilized resources.

Local Irrigation and State Assistance: Wider Generalizations

The research findings that derive from the study in Pidie suggest the need to reexamine earlier discussions of direct and indirect investment strategies. In the original formulation a choice was posed between direct and indirect investment strategies---one or the other. The Pidie materials suggest the need to modify this approach.

In particular, where there is need to increase or stabilize the supply of water at the point of diversion, a combination of direct and indirect strategies could be the preferred approach. Investment in the improvement of the headworks facilities often will be best accomplished through direct investment approaches because of the technical expertise required in design and construction, the level of funds that are necessary, and the operational and repair capacities needed following construction. When using this mixed strategy, a key concern is to not let the state involvement in the headworks portion of the system be a driving force for direct state involvement in the lower parts of the system or a means for displacing local institutions and leadership. One way to avoid these problems is to employ an indirect investment strategy as a means of assistance for improvements in irrigation facilities below the headworks.

The Pidie data also suggest some wider generalizations regarding local irrigation institutions. First, if effective local irrigation institutions are in place, then indirect investment is a plausible strategy. In their absence it is not. In the latter case, the indirect investment strategy would need to be complemented by local institution building efforts that may be slow, costly and uncertain in outcome. Nevertheless, this may be preferable to a strategy that leads to

perpetual state responsibility for system operation and maintenance. A second point that we see from Pidie is that local authorities can act in ways that build on customary irrigation institutions rather than replacing them with new and untested social arrangements. The ordinance issued by the District Head outlining the elements of the keujreun institution, while perhaps based on imperfect information, is nonetheless an excellent example of the affirmative steps that can be taken to legitimize, and perhaps update, existing local arrangements for irrigation management.

Finally, it should be noted that the Pidie case suggests the more general point that local government can be an effective instrument for organizing local irrigation. It is an alternative to the water users' association model that has come to dominate much of our thinking about local irrigation institutions. This is not to suggest that it is everywhere an appropriate substitute, but merely to stress that it offers a choice with its own peculiar strengths and limitations.

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