Linking Main and Farm Irrigation Systems in Order to Control Water

Volume 4:
The Case of Lam Chamuak, Thailand

Water Management Synthesis Project
WMS Report 69

LINKING MAIN AND FARM SYSTEMS IN ORDER TO CONTROL WATER

VOLUME 4:

THE CASE OF LAM CHAMUAK, THAILAND

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PREFACE

In recognition of the importance of water management for improving irrigated agricultural production, Water Management Synthesis II Project developed several activities related to irrigation system management. One such activity was the special studies research program initiated by Colorado State University. The program examined formal and informal organizational relationships between main system managers and farmers in their efforts to control water in four irrigation systems in Pakistan, India, Thailand, and Sri Lanka. The information that was obtained is presented in the following five volumes:

Linking Main and Farm Irrigation Systems in Order to Control Water. WMS Report 69. Water Management Synthesis Project, Colorado State University, Fort Collins.

- Volume 1: Designing local organizations for reconciling water supply and demand (D.M. Freeman).
- Volume 2: A case study of the Niazbeg distributary in Punjab, Pakistan (E. Shinn and D.M. Freeman).
- Volume 3: A tank system in Madhya Pradesh, India (V. Bhandarkar and D.M. Freeman).
- Volume 4: The case of Lam Chamuak, Thailand (K. Paranakian, W.R. Laitos, D.M. Freeman).
- Volume 5: Two tank systems in Polonnaruwa District, Sri Lanka (J. Wilkens-Wells, P. Wilkens-Wells, D.M. Freeman).

The reader is advised that reading Volume 1 will enhance his or her understanding of the significance of the information reported in volumes 2-5.

EXECUTIVE SUMMARY

This report constitutes the fourth volume in the Water Management Synthesis II special studies series. It reports findings of a study of farmers and main irrigation system management officials on the Lam Chamuak tank irrigation project in northeast Thailand. A sample was intensively studied during 1985 and 1986 of 54 farmers (3 farmers from each of 18 sample turnout groups) who received some amount of irrigation water from the Lam Chamuak irrigation system. These farmers represented head, middle, and tail positions on both the right and left main canals served by the Lam Chamuak dam and reservoir. In addition to these farmers, researchers investigated the situation of 63 sample farmers at the extreme tail of the system who were originally included in the irrigation system but who, given their location, have rarely, if ever, received canal water. The total sample size, therefore, was 117 farmers. Data reported here were gathered during dry and wet seasons.

What was found? A local farmer water users association (WUA) was established by the Royal Irrigation Department (RID) in 1978 and local farmers have filled a full slate of organizational positions. Recruited locally and responsible to irrigators, farmer leaders were found to be attempting to work with the organizational skeleton that exists at Lam Chamuak in the form of the WUA and the turnout groups (TOG). However, these organizational units were not operating well enough to effectively allocate water, perform maintenance, or resolve water-related conflicts. Therefore, farmer enthusiasm for sustaining the inevitable costs of organizational membership appeared to be diminishing.

Specifically, data revealed that the WUA, given the lack of appropriate physical tools for controlling and measuring water and the lack of viable rules for water distribution, has not delivered water equitably to all locations in at least two senses. First, farmers in the extreme tail have not had water delivered in years and have virtually abandoned the system. Second, farmers in areas served by canal flows primarily depend upon favorable location for obtaining access to water -- the organizational arrangements have been insufficient to overcome the head-tail delivery problems posed by geography. Relationships between water delivery and location are straightforward -- the more one moves from head to tail locations on the main canals and along ditches, the less reliable and adequate is water delivery. Reports of farmer satisfaction with water delivery mirror the objective situation -- less satisfaction was reported by sample farmers in the tails of the system as compared to those at the head.

The president of the water users association is more active and successful in securing water flows and allocating them than in promoting routine maintenance. The WUA president has had considerable positive impact in mobilizing farmers during periods of emergency occasioned by having too much or too little water. Maintenance activity by farmers is considerably greater with respect to wet season needs than for dry season requirements.

Dry season cropping intensities were especially low, and paddy yields were directly and positively related to water availability and control. Farmers in the head reaches with the best water control produced the highest mean paddy yields.

Farmers from outside the command area potentially affect water supplies and control. A large group of "encroachers" consume tank water during the dry season, and another smaller group near the tail of the left main canal draws water from that canal. Overall, these groups, which are not officially sanctioned by RID, more closely exhibit the characteristics of effective local organization because they operate with the full expectation that they must bear costs of water control, and they have devised clear rules for water allocation and maintenance. Those in the group who might wish to take water without paying a fair share of the water management costs are deterred by certain denial of water supply. Any rehabilitation of the system must take into account the irrigation agendas of these "outsiders."

The available information indicates that farmers inside and outside the system are willing to participate in effective local organizations to manage irrigation water when they see direct benefits for themselves and when organizational leadership enforces rules to insure that some farmers are not allowed to exploit the work of others. Some TOG leaders have gone a considerable way to organize their TOGs for routine maintenance; other turnout groups have floundered. All the turnout groups lack adequate organizational devices to link themselves with each other (within and among TOGs) and with RID main system management. Farmers and RID officials made it clear that they prefer a decentralized approach to water management at Lam Chamuak.

There are several important implications of all this. First, policymakers are asked to recognize the degree to which at least a portion of the TOGs have constructively adjusted to the lack of adequate organizational linkage to each other and main system management upstream. Some TOGs have accomplished much by using and generating support for the TOG leader's role in allocating water, performing maintenance, and managing water-related conflict. Second, the strong and sustained relationship between TOG organization, water control, and yields implies a priority for securing greater main system support for local organizational development between farmers and main system management. Third, farmer willingness to support viable local water users association(s) should not be underestimated. The desire is substantial.

These implications reinforce the crucial nature of designing and implementing, with main system support and main system respect for local organizational autonomy, appropriate water users associations at the middle management level. Proper design and implementation of such organizations can do much to reduce problems for both farmers and main system management. Concepts and procedures for such organizational design are addressed in Volume 1 of this series of reports: **Linking Main and Farm Irrigation Systems in Order to Control Water: Designing Local Organizations for Reconciling Water Supply and Demand.**

I. INTRODUCTION

Thailand is geographically divided into four regions: the North, Northeast, Central, and South. The northeast region is the largest of the four, containing approximately one-third of Thailand's land area and population. Unfavorable natural and social features, however, have limited economic development in northeast Thailand.

Topographically, northeast Thailand is a gently undulating plateau. The surface soils in this area are generally infertile, sandy, permeable, and poorly drained. The poor drainage is a result of horizontally stratified, mesozoic sandstone underlying the surface soils, and rolling relief. Erratic rainfall produces droughts and floods. These climatic and topographic factors limit crop production, and many people have left the Northeast to seek temporary jobs in Bangkok and in other regions. The Northeast is the least developed region in Thailand.

Recognizing the need for economic development in the Northeast, the Royal Thai Government has improved rural roads and flood control works. They have established communication links and have constructed many irrigation and multipurpose dams.

Irrigation has been a high priority. Before World War II, however, irrigation was not common in northeast Thailand. In 1947, Thailand's Royal Irrigation Department (RID) first constructed a few small tanks as pilot projects in the northeast. Tank irrigation was later recommended by the FAO and other foreign donors as the best solution to the region's water shortages.

By 1985, there were about 223 medium tank irrigation projects in the Northeast (including diversion weirs and tanks for domestic use) which totaled 1,010 million cm^3 of storage and included an estimated irrigable area of 231,472 ha (1,446,702 rai). The actual irrigated area reported by the Planning and Budgeting Division of RID (August 1986) was 174,668 ha (1,091,673 rai).

In the last few years, RID has realized that the area actually irrigated by the tanks is considerably smaller than the designed irrigated area. A lack of distribution facilities and maintenance, coupled with a generally inadequate supply of water, has contributed to a situation where water distribution is unreliable and inequitable.

In an attempt to respond to these problems in northeast Thailand, USAID/Thailand and RID instituted the Northeast Small-Scale Irrigation Project (NESSI) in the early 1980s. The purpose of NESSI is to assist RID in rehabilitating and improving seven small/medium-scale irrigation projects in northeast Thailand. NESSI is also to "establish a replicable approach and the necessary institutional capabilities for increasing agricultural incomes for poor farmers in small/medium-sized irrigation areas of northeast Thailand."

The Lam Chamuak irrigation system in Nakhorn Ratchasima (Korat) Province was chosen as one of the seven NESSI sites. Lam Chamuak is a surface-water, gravity-flow, tank irrigation system, with a designed command area of 13,500 rai (2,160 ha). RID and NESSI plan to extensively rehabilitate and improve the physical and institutional structure of Lam Chamuak (Figure 1).[1]

This research report describes and analyzes the management and performance of the Lam Chamuak irrigation system before rehabilitation. The report focuses on RID's main system managers, the farmers' water users' association (WUA), turnout groups (TOGs), and individual farmers. The paper examines how the social organization of irrigation at Lam Chamuak affects the type and quality of the farmers' water control, and how that water control affects the system's performance and the agriculture of the area.

The research also examined how social structure and ethnic differences affected irrigation at Lam Chamuak. Physical features of the system, such as field topography, and different sources of irrigation water were also studied.

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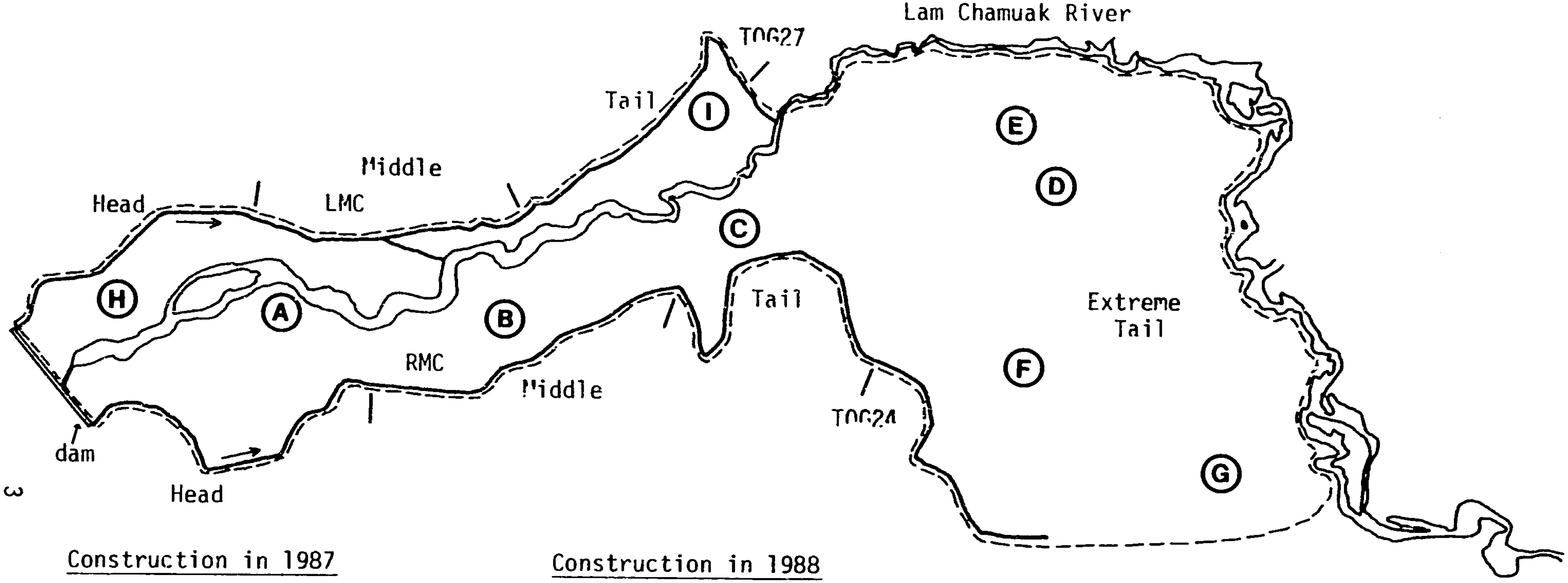
[1]The institutional rehabilitation of Lam Chamuak was taking place during this research. Irrigation community organizers (ICOs) were posted at Lam Chamuak in late 1985 to work with farmers to rebuild and strengthen local irrigation organizations through most of 1986. Their activities, however, did not affect the results of the social science research for 1986. See Appendix A for a report of the ICO activities.



Construction in 1987

Block A - 953 rai
Block B - 591 rai
Block C - 908 rai

Total Area = 2,452 rai

Construction in 1988

Block D - 1,803 rai
Block E - 1,776 rai
Block F - 911 rai
Block G -
Block H - 1,297 rai
Block I -

Total Area = 5,787 rai

--- Proposed command area
RMC Right main canal
LMC Left main canal

Figure 1. Lam Chamuak irrigation system, Thailand.

II. RESEARCH METHODS

The Lam Chamuak irrigation system was selected as the research site because it was the last of the seven NESSI sites. Though rehabilitation was planned, no physical rehabilitation of the system had started by 1985-86, when the research was conducted. Therefore, Lam Chamuak was not influenced by NESSI rehabilitation activities during the study period, and the data collected should help RID and NESSI to design, implement, and evaluate their rehabilitation activities. In addition to the research completed prior to the rehabilitation, it was hoped that research would continue during and after construction as well.

Employing concepts of the CSU/WMS II special studies effort (Volume 1), and with the support of the Colorado State University research team, two Thai researchers were responsible for designing and implementing the social science research. The senior author, an assistant professor of sociology from Bangkok's Kasetsart University, served as the senior social science field researcher. She had overall responsibility in Thailand for designing and doing the research. Although based in Bangkok, she traveled to Lam Chamuak frequently.

A young graduate (B.A.) in sociology from Kasetsart University was hired as a social science research assistant. He lived at Lam Chamuak and collected detailed social science data. Before he left for Lam Chamuak, he reviewed data gathering methods relevant to social science, particularly participant observation. He also reviewed the written literature on the Lam Chamuak system.

The research assistant moved to Lam Chamuak in October 1985 and lived there continuously through 1986 and 1987. For the first few months he lived with an abbot from a Buddhist temple. To become more familiar with the farmers at Lam Chamuak, he then rented a house near the right main canal and lived there for approximately one year. Currently, he rents a house close to the left main canal.

Three social science researchers and one engineer from Colorado State University helped the Thai researchers. A RID research engineer also contributed engineering data to the research. In 1986 he spent approximately 50 percent of his time at Lam Chamuak.

At the beginning of the research effort, the research team[2] decided that four different social science data collection methods would be used: sample surveys, qualitative key informant interviews and case studies, participant observation, and use of secondary sources.

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[2]The members of the research team were Kanda Paranakian, senior social science researcher; Petch Ansaart, research assistant; Dr. W. Robert Laitos, sociologist; Dr. Dan Lattimore, technical journalist; Dr. Alan Early, agricultural engineer; and Dr. David Freeman, sociologist.

A. SAMPLE SURVEYS

In early 1986, the senior Thai social science researcher developed an interview schedule to administer to sample farmers at Lam Chamuak (Appendix B). The purpose of the interview schedule was to quantify variables that could measure properties of social structure, farmers' attitudes, and irrigation behavior. To accomplish this, the interview schedule focused on:

* Background and social structure, including landholding size and tenurial status.

* Agricultural performance, including cropping patterns, crop varieties, agricultural inputs, crop yields, and reasons for non-cultivation.

* Irrigation performance, including farmer and RID irrigation behavior and perceived problems, system operation and maintenance (O&M), water sources, and adequacy, reliability, and equity of water deliveries.

* Water users' association (WUA) and turnout group (TOG) activities and problems.

* Information exchange and communication.

* Farmers' satisfaction with the irrigation system.

* Farmer's willingness to participate in system rehabilitation.

* Farmers' expectations of system rehabilitation.

A stratified, multi-stage, cluster sampling design was used to select sample farmers. Lam Chamuak was first divided into two separate areas: 1) an area that usually received some water from the Lam Chamuak tank (approximately 5,000-6,000 _rai_ or 800-960 ha), and 2) an area at the extreme tail of the system (approximately 6,000-7,000 _rai_ or 960-1,120 ha) that had rarely, if ever, received irrigation water from the Lam Chamuak tank. The original Lam Chamuak design was to have served this extreme tail area.

In the area that usually received canal water, the turnouts were divided into two groups: those along the left main canal (LMC) and those along the right main canal (RMC). There were 27 TOGs on the LMC and 24 TOGs on the RMC.[3]

The TOGs on each main canal were stratified by location from the tank into head, middle, and tail regions. Three TOGs were randomly

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[3]There were 23 TOG leaders on the LMC and 23 TOG leaders on the RMC. TOGs 2 and 3, 17 and 18, 19 and 20, and 25 and 26 on the LMC shared leaders. On the RMC, TOGs 14 and 15 shared a leader.

selected from the head, middle, and tail of the LMC and the RMC. There were a total of 18 TOG samples: nine from the LMC and nine from the RMC as displayed in Table 1.

Table 1. Turnout groups randomly selected to represent three locations each on the LMC and RMC of Lam Chamuak.

Location	LMC TOGs Selected	RMC TOGs Selected
Head	3, 5, 8	1, 3, 7
Middle	13, 17-18, 19-20	9, 11, 16
Tail	24, 25, 27	17, 22, 24

The farmers of each selected TOG were then stratified by their farm location (head, middle, and tail) along the ditches leading from the main canals. One farmer was randomly selected from the head, middle, and tail subgroup of each TOG. This resulted in a sample of 54 farmers (3 farmers were chosen from each of the 18 sample TOGs).

Twelve of the farmers originally selected, however, were dropped from the initial sample. The research assistant discovered that these 12 were inappropriate as sample farmers because 1) some were owners of the land, but did not cultivate it themselves due to old age; 2) in certain instances the owner was deceased; 3) land was being sold; or 4) they had moved somewhere else and had rented their land to others. Since the sample farmers had to be the persons who actually farmed and irrigated the land, 12 new farmers were randomly selected.

The final 54 sample farmers from the area that usually received some canal water were distributed as shown in Table 2.

Table 2. Distribution of sample farmers by location in the LMC and RMC TOGs of Lam Chamuak.

Location	Left Main Canal	Right Main Canal
Head	10	8
Middle	8	11
Tail	9	8
Total	27	27

A slightly different sampling procedure was used to select farmers from the extreme tail, an area that seldom, if ever, received water from Lam Chamuak tank. All of these potential Lam Chamuak water users are located along an abandoned section of the RMC, the longer of the two main canals. The TOGs along the extreme tail of the RMC were grouped by several main ditches as shown in Table 3. Approximately half of the TOGs along each main ditch were randomly selected, resulting in 21 sample TOGs.

Table 3. Turnout groups randomly selected to represent locations on the extreme tail of the RMC of Lam Chamuak.

Ditch Name (RID)	Number of TOGs	Number of TOGs Randomly Selected
1L-2L	12	6
2L	9	5
3L	3	1
4L	1	1
5L	7	3
1R-5L	2	1
6L	7	3
TOG 39	1	1
Total	42	21

The farmers along each sample turnout were stratified as head, middle, or tail farmers. One farmer was randomly selected from each head, middle, and tail subgroup along the 21 sample turnouts. Therefore, the total sample size for the extreme tail was 63 farmers.

The 54 sample farmers from the area that usually received Lam Chamuak water and the 63 sample farmers from the extreme tail provided a total sample of 117 farmers.

B. QUALITATIVE KEY INFORMANT INTERVIEWS AND CASE STUDIES

Key informant interviews and individual case studies were qualitative and used open-ended questions and in-depth probing to obtain information. The key informant interviews and case studies emphasized the depth of investigation, of important variables and concepts. Structural issues, such as conflict and WUA rules, were stressed.

After reviewing the field diaries of the process documentor, and in consultation with the research assistant (who had by that time spent several months at the research site), the senior author developed two interview schedules for key informants: one for farmers and one for relevant government officials (Appendices C and D).

The key informant interview schedule for farmers covered the following topics:

* The key informant's background.
* Perceived irrigation problems.
* The nature of conflict at Lam Chamuak.
* Lam Chamuak O&M procedures and water adequacy, reliability, and equity.
* The structure and operation of the Lam Chamuak WUA and TOGs, including group rules and punishment for violators.
* An "open" section, where the farmers could voice their opinions on any issue that concerned them.

Thirty-four farmers were interviewed as key informants. Their social positions in the system are presented in Table 4.

Table 4. The social positions of farmers interviewed as key informants in Lam Chamuak.

Position	Number of Farmers
Turnout group leader	15
Village headman	8
Present or former WUA president	3
TOG leader's assistant	1
Chairman of co-op	1
Vice chairman of co-op	1
Senior village committee member	1
Area committee member	1
Area committee assistant member	1
No formal position	1

The key informant interview schedule for government officials covered slightly different topics:

* Background of the key informant.
* Government officials' and farmers' perceived irrigation problems.
* Nature of conflict at Lam Chamuak.
* System O&M procedures.
* Suggestions for improving the functioning of WUAs, including the effectiveness of current rules and punishments.
* Potential actions government officials would take under certain circumstances.

Fifteen government officials were interviewed at Lam Chamuak. Their professional positions were as follow in Table 5.

Table 5. The professional positions of government officials interviewed as key informants in Lam Chamuak.

Position	Number
Irrigation community organizer	7
Canal caretaker	3
Tank caretaker	1
Zoneman	1
NESSI technician	1
Provincial irrigation engineer	1
District O&M (water master)	1

In addition to the key informant interviews, the research assistant also prepared eighteen in-depth farmer case studies: nine on the LMC and nine on the RMC at the head, middle, and tail of each main canal. At each location, the research assistant spent at least one entire day with a farmer, gathering data on all aspects of his irrigation operations. The 18 case studies were chosen to coincide with the RID field research engineer's data collection sites.

C. PARTICIPANT OBSERVATION

Since the research assistant lived at Lam Chamuak, he was able to actively observe farmers' and officials' irrigation and social behavior during that time. The research assistant observed TOG meetings, local government council meetings, WUA meetings, and many informal gatherings of farmers and officials.

He kept detailed field diaries which were periodically reviewed by the senior author. These field diaries provided the deepest understanding of the behavior observed at Lam Chamuak. Additionally, many of the questions used in the sample survey and key informant interview schedules were based on the research assistant's observations.

D. SECONDARY SOURCES

Secondary information was gathered to prepare for the research and, later, to check data reported by farmers. These sources included government data on cropping patterns and yields in wet and dry seasons, and on water supply throughout the year. Research data from RID engineers, the provincial irrigation office, and the Sixth Regional Office were also used, including water measurements, crop yields, and soil tests.

III. THE AGRICULTURE AND AGRARIAN SOCIAL STRUCTURE OF LAM CHAMUAK IRRIGATION SYSTEM

A. CLIMATE

Like most of Southeast Asia, Lam Chamuak has annual wet and dry seasons. Lam Chamuak's wet season lasts from May to October. During this time, rainfall averages more than 200 mm/month. In September of 1985, 316 mm were measured at Lam Chamuak. Between March and November, total rainfall averages are between 900 mm and 1,000 mm. The average annual rainfall at Lam Chamuak is about 1,100 mm.

The dry season lasts from November to April, with an average rainfall of less than 100 mm/month. Tropical cyclones, however, can occur from September to November and may deposit more than 100 mm in one or two days. The weather is cooler, with no rainfall from November to February. Hot and dry weather follows in the spring until the wet season begins.

B. LAM CHAMUAK AGRICULTURE

Most of the cropping at Lam Chamuak takes place during the wet season, when paddy (rice) is the predominant crop. Paddy is primarily grown in the irrigated lowlands, while cassava and sesame are grown in the highland areas where irrigation is difficult. Small amounts of fertilizer (10-15 kg/rai or 63-94 kg/ha) are used on paddy. Average paddy yields at Lam Chamuak are about 400 kg/rai (2.4 mt/ha), though it is not unreasonable to expect paddy yields as high as 600-700 kg/rai (3.8-4.4 mt/ha).

Paddy is produced primarily for home consumption, but some farmers sell their paddy little by little if they need extra cash. Paddy sells at approximately 2.40 baht ($0.10)/kg. Cucumbers, beans, sweet corn, peanuts, melons, and pumpkins are also grown in the wet season for home consumption and local sale.

Dry season irrigated agriculture is not popular at Lam Chamuak. Farmers cultivate cash crops in the dry season, such as cassava and sesame, that require little water. Cassava requires water only to loosen the soil during harvesting, and sesame needs water only during land preparation. In fact, too much water can harm cassava and sesame. Fruit trees (mango, banana, coconut, and jack-fruit) are also grown near farm houses for home consumption.

Many modern agricultural technologies are present at Lam Chamuak. In addition to irrigation, some chemical fertilizers are used and small tractors are owned or used by most Lam Chamuak farmers. Locally produced small trucks carry produce to nearby markets.

Though Lam Chamuak is a rural, agricultural area, most farmers interviewed did not want their children to start careers in agriculture. Eighty-seven percent of the sample farmers said that they want their children to enter non-agricultural occupations. Two-thirds of these farmers said that they want their children to become office workers or government officers, because these occupations provide regular incomes.

C. INCOME AND EMPLOYMENT

Crop production is a main source of income for Lam Chamuak farmers. Pensawang[4] reports that the Lam Chamuak farmers' mean annual gross income from agriculture is 31,592 baht ($1,263). These income figures varied from 5,000 baht ($200) to 99,740 baht ($3,989).

Sale of cassava in particular generates considerable income. Slightly more than half of the 117 sample farmers reported that they earned some income from cassava production, either on lands within the Lam Chamuak command area, or on land they owned outside the command area. Among the sample farmers, the average yearly gross income from cassava production was 17,345 baht ($690). The lowest yearly income from cassava production was reported at 600 baht ($24) and the highest was 90,000 baht ($3,600).

Assuming a relatively low cassava price of 1.0 baht ($0.04)/kg, Pensawang[5] reports that a Lam Chamuak farmer with 10 rai (1.6 ha) of cassava could easily enjoy a net income of 5,500 baht ($220). Lam Chamuak farmers have stated that without cassava production, their lives would be "miserable." As long as the market price of cassava is reasonable, Lam Chamuak farmers will continue to grow it.

Cassava production also provides employment opportunities. In the dry season, many farmers and laborers work on cassava farms controlling weeds and picking roots. The daily wage rate for such labor is 25-30 baht ($1.00-1.20). Such employment is available at Lam Chamuak and at cassava plantations outside of Lam Chamuak. Owners of cassava plantations outside of Lam Chamuak usually send trucks in the morning to pick up the laborers and to drop them off at their homes in the evening.

Farmers working in cassava production were usually married. There were cases in the dry season when all family members moved together to work on cassava plantations and returned to Lam Chamuak for wet season paddy cultivation.

Young, single, male farmers often leave Lam Chamuak in the dry season to seek employment in the large cities of Korat or Bangkok. There they work as construction laborers, factory workers, security guards, and in other service industries. Some female migrants also leave Lam Chamuak for larger cities to work as dressmakers, waitresses,

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[4]Pensaweng, P. 1982. Problems of water use and water management in northeast Thailand: a case study of Huai Lam Chamuak Irrigation Project. Bangkok, Thailand: Asian Institute of Technology. [Thesis.]

[5]Pensaweng. 1982.

factory workers, and housemaids. Some males have migrated abroad to work as construction laborers in Singapore, Saudi Arabia, and Kuwait.

Many laborers migrated because their land is infertile or inaccessible to water or because they needed cash for personal or family expenses. Those laborers who had permanent jobs usually returned to Lam Chamuak for the holidays. Those who worked abroad stayed abroad as long as they could find employment. Pensawang[6] reported that annual off-farm income at Lam Chamuak ranged from 125 baht ($5) to 42,000 baht ($1,680).

Older farmers tend to remain at Lam Chamuak during the dry season to tend cattle and practice bamboo weaving. Approximately one-third of the sample farmers reported that they raise silkworms to produce high quality Thai silk. Another one-third reported that they sell rosehips.

Employment opportunities are available to Lam Chamuak residents in the wet season also. About one-half of the sample farmers reported that they hire labor during paddy cultivation, primarily during uprooting, transplanting, and harvesting. During land preparation, labor was hired at 120-130 baht ($4.80-5.20)/rai ($30-$32.50/ha). Hired laborers for uprooting were paid 25-30 baht ($1-$1.20)/100 roots. Hired labor for transplanting was paid a more standard wage rate of 25-30 baht ($1-$1.20)/day. Lam Chamuak female laborers preferred to work in uprooting because they earned more than for transplanting.

Other employment opportunities are available for skilled laborers. A few farmers drive tractors for 300 baht ($12)/day. Carpenters are paid approximately 60 baht ($2.40)/day.

Lam Chamuak farmers, therefore, can derive income from crop production (primarily cassava and sesame) and wage labor. Compared to the rest of rural northeast Thailand, Lam Chamuak farmers are relatively prosperous.

D. HOUSEHOLDS AND ETHNIC GROUPS

At the time of the study, there were approximately 1,080 households in the original Lam Chamuak target area of 13,500 rai (2,160 ha). The total population was approximately 7,000 people. Schools and Buddhist temples were common. Electricity was provided throughout the area and some farm houses had television sets.

There were two different ethnic groups represented at Lam Chamuak: Thai Korat (old Thai) and Thai Esan (new Thai). Many of the Thai Esan arrived in Lam Chamuak about 40 years ago, before the irrigation system was built. They settled in two villages that are now at the head of the irrigation system, and as relative newcomers Thai Esan are generally considered to be poorer than Thai Korat. The two ethnic groups speak different dialects of the Thai language. Furthermore, Thai Korat usually cook their food with oil or coconut milk and eat non-glutinous

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[6]Pensaweng. 1982.

(non-sticky) rice. Thai Esan practice ancestor worship, eat glutinous rice, and food with oil or coconut milk is uncommon among them.

The Thai Korat and some Thai Esan are located in the Department of Public Welfare's Land Settlement Scheme in seven villages in the middle and tail of the irrigation system. Each household in this scheme was allotted approximately 23 rai (3.7 ha) of land. Houses and roads are well designed and maintained.

The distribution of Thai Korat and Thai Esan within the group of sample farmers is displayed in Table 6. Most of the Thai Esan in the sample lived and farmed near the head of the irrigation system, while most of the Thai Korat in the sample lived and farmed in the land settlement scheme at the middle and tail of the system. In addition, all 63 of the sample farmers who lived in the extreme tail were Thai Korat.

Table 6. Location of Thai Korat and Thai Esan sample farmers in Lam Chamuak.

	Head	Middle	Tail	Extreme Tail
	----------------number of farmers*----------------			
Thai Esan	16(89)	8(42)	1(6)	0
Thai Korat	2(11)	11(58)	16(94)	63(100)

*() = Percent of total number of sample farmers.

Table 6 reveals that approximately 75 percent of the 117 sample farmers were Thai Korat. This accurately reflects the ethnic distribution throughout the irrigation system.

Marriage between the two ethnic groups is relatively common. After marriage, members of one ethnic group often move to a different village to live with their spouses from the other ethnic group. No conflicts were reported between the two ethnic groups.

E. LANDHOLDING

Lam Chamuak farmers own and cultivate relatively small plots of land within the command area. Over two-thirds of the sample farmers have only one plot of land within the Lam Chamuak command area (Table 7). Ninety percent of the sample farmers farm only one or two plots. Landlessness at Lam Chamuak is rare.

Table 8 shows the distribution of landholding sizes for the sample farmers within the command area, outside the command area, and the total land owned. For the 117 sample farmers, the mean land size owned inside or outside the scheme is about 25 rai or 4.0 ha. Total landholding size averages 50 rai or 8.0 ha.

Table 7. Number of parcels cultivated in Lam Chamuak command area by sample farmers.

Number of Parcels Cultivated	Number of Respondents	Percent
0	1	1
1	80	68
2	26	22
3	6	5
4	2	2
5	1	1
8	1	1

Table 8. Distribution of mean and extreme landholding sizes for sample farmers in Lam Chamuak.

	Mean Size	Largest Individual Landholding	Smallest Individual Landholding*
	rai (hectares)		
Within command area	23.2 (3.7)	179.0 (28.6)	3.0 (0.5)
Outside command area	25.3 (4.0)	189.0 (30.2)	3.0 (0.5)
Total land owned	49.7 (8.0)	251.0 (40.2)	4.0 (0.6)

*Only one farmer reported no land owned within the command area, and a few more reported no land owned outside the command area.

When the data are disaggregated into head, middle, and tail positions along the LMC, the RMC, and the extreme tail (Table 9), the differences in mean landholding sizes appear to be evenly distributed throughout the system. There are no large differences in the mean landholding sizes at the different locations. The smallest mean landholding size within the command area is 18.1 rai (2.9 ha) and the largest is 27.4 rai (4.4 ha). Mean total landholding sizes only vary from 38.3 rai (6.1 ha) to 58.9 rai (9.4 ha).

The mean landholding size differences displayed in Tables 8 and 9 do not appear large enough to affect the operation of Lam Chamuak irrigation activities. Landholding figures indicate a relatively equitable distribution of land at Lam Chamuak.

There were also no significant differences in landholding sizes between the Thai Esan and Thai Korat. Table 10 demonstrates that the mean landholding sizes are nearly identical. Therefore, one ethnic group does not possess an advantage over the other due to significantly larger landholding sizes.

Most Thai Korat moved to Lam Chamuak from nearby districts. The Thai Esan, though residents of Lam Chamuak for a longer time, moved from districts further away. Therefore, though both ethnic groups own land outside the command area, the outside land of the Thai Korat is usually closer to their Lam Chamuak homes.

Table 9. Distribution of mean landholding sizes in Lam Chamuak (by location).

	LMC			RMC			Extreme
	Head n=10	Middle n=8	Tail n=9	Head n=8	Middle n=11	Tail n=8	Tail n=63
	rai (hectares)						
Within command area	18.1 (2.9)	21.8 (3.5)	25.2 (4.0)	22.5 (3.6)	27.4 (4.4)	18.6 (3.0)	23.9 (3.8)
Outside command area	26.3 (4.2)	37.1 (5.9)	20.7 (3.3)	15.8 (2.5)	20.5 (3.3)	32.0 (5.1)	25.5 (4.1)
Total land owned	44.4 (7.1)	58.9 (9.4)	44.8 (7.2)	38.3 (6.1)	52.4 (8.4)	50.6 (8.1)	50.9 (8.1)

Table 10. Mean landholding sizes of Thai Esan and Thai Korat in Lam Chamuak.

	Thai Esan n=25		Thai Korat n=92	
	rai (hectares)			
Within command area	21.8	(3.5)	23.6	(3.8)
Outside command area	25.8	(4.1)	25.1	(4.0)
Total land owned	47.6	(7.6)	50.3	(8.0)

Table 11 shows the sample farmers' landholding status on their primary[7] parcel of land in the paddy season. Ninety-one percent of the farmers who responded said they were owner-operators. Very few of the sample farmers said they were engaged in any form of tenancy, and only

[7]Primary parcel of land: For those farmers who own more than one parcel of land, the primary parcel is that upon which crops are grown first, particularly in times of water scarcity.

three percent of the farmers had left some part of their parcels uncultivated.[8]

Table 11. Land ownership status of primary parcel of land in wet season, Lam Chamuak (n=107).

Land Ownership Status	Number of Responses	Percent
Owner, cultivating all of parcel	97	91
Owner, leaving some uncultivated	3	3
Tenant (but may have outside land or income)	3	3
Owner, but some rented in	2	2
Owner, but relatives using free	1	1
Owner, but rented out	1	1

Tenancy is uncommon at Lam Chamuak. In the dry season of 1986, the field research engineer reported that there were only 55 tenant farmers in the command area, out of approximately 1,000 households. Some of these 55 farmers were tenants only, while others owned land, but leased land to augment their holdings.

At Lam Chamuak, land is rented at a fixed rate or a flexible rate. The fixed rate can be paid in cash (according to total farm size or per rai) or in kind (3-5 tang (1 tang = 20 kg) of paddy per rai). The flexible rate is usually paid in kind, with a certain percent of the production to the tenant and the rest to the owner.

Most farmers and tenants did not make written contracts. Those renting land were not sure how long they could continue to rent the land. Some of the landowners and tenants were relatives and others were long-time friends. Tenants and owners often joined together in social activities. There were a few absentee landlords, and their tenants stated that they had never had any contact with them.

The comparatively few farmers owning a second parcel of land were asked about the land ownership status of that land. None of the sample farmers reported personally cultivating all of the second parcel of land. The farmers owning a second plot of land either leave all or part of that plot uncultivated, let relatives cultivate the land for free, or rent all or part of the land out.

In the dry season, agriculture is less important to many Lam Chamuak farmers. Half the sample farmers leave at least part of their land uncultivated in the dry season (Table 12).

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[8]In Table 11, and elsewhere throughout this report, some percentages do not add to 100 due to rounding error.

Table 12. Cultivation status for primary parcel of land in the dry season, Lam Chamuak.

Cultivation Status	Number of Responses	Percent
Owner, but leaving some uncultivated	55	51
Owner, cultivating	47	44
Owner, but relatives using free	2	2
Owner, but some rented in	2	2
Tenant (but may have outside land or income)	1	1

Disaggregating dry season data into different locational categories reveals an interesting distribution. Table 13 reports that the proportion of owners who cultivate all of their primary parcels is high at the heads of canals and much lower at the tail and extreme tail. In addition, the proportion of farmers leaving at least part of their primary parcel uncultivated increases from the heads of main canals to the tails. In the dry season, then, farmers cultivating land are more likely to be concentrated at the head.

As one would expect after noting that Thai Esan are concentrated in the head reaches of the command area, a greater proportion of Thai Korat leave at least part of their primary parcel of land uncultivated in the dry season than do the Thai Esan (Table 14). Furthermore, Thai Esan prefer to grow sesame in the dry season, which requires little water, while the Thai Korat often cultivate their landholdings outside of the Lam Chamuak command area.

Table 13. Cultivation status of primary parcel of land in the dry season (by location and ownership).

Cultivation Status	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail	Extreme Tail
	------	------	------	number of responses*	------	------	------
Owners cultivating all of parcel	7 (70)	4 (57)	2 (29)	7 (88)	6 (55)	4 (57)	17 (30)
Owner, leaving some uncultivated	2 (20)	2 (29)	5 (71)		3 (27)	3 (43)	40 (70)
Owner, but relative using free				1 (12)	1 (9)		
Owner, but some rented in			1 (14)		1 (9)		
Tenant	1 (10)						

*() = Percent of total responses from farmers at that location.

Table 14. Cultivation status on primary parcel of land in dry season (by ethnic group and ownership).

Cultivation Status	Thai Esan	Thai Korat
	-----number of	responses*-----
Owner, leaving some uncultivated	4 (17)	51 (61)
Owner cultivating all of parcel	17 (71)	30 (36)
Owner, but relatives using free	2 (8)	
Owner, but some land rented in		2 (2)
Tenant (but may have outside land or income)	1 (4)	

*() = Percent of total responses from sample farmers.

IV. THE PHYSICAL AND ORGANIZATIONAL CHARACTERISTICS OF LAM CHAMUAK

A. THE PHYSICAL SYSTEM

The Lam Chamuak tank irrigation system is located in Pimai District, approximately 100 km east of the large city of Korat in Pimai and Nakhorn Ratchasima (Korat) province. It is a surface water, gravity flow, canal system designed to supplement rainfall for paddy production in the wet season. Dry season water releases are smaller than wet season releases. Farm families also use the water for domestic household chores and to water livestock.

The Lam Chamuak irrigation system began operating in 1968. A 1,500-m earthen dam across the Chamuak River stores water for the system. Though reduced to a small stream below the dam, the Chamuak River flows through the command area. The annual storage rating of the dam is between 12-20 million m^3. The capacity at design storage level (+176.3 m MSL) is 23.445 million m^3.

Depending on rainfall and river flow, the water level and supply in the tank fluctuates from year to year and within each year. In December 1975 and September 1976, the water level in the reservoir was lower than the lower edge of the outlet. In 1983, the water level reached 0.70 m above the design level. Similarly, the reservoir storage reached 8.8 million m^3 in April 1980, 5.6 million m^3 in October 1981, 2.15 million m^3 in July 1982, 12.3 million m^3 in July 1983, 16.5 million m^3 in May 1984, and 3.0 million m^3 in August 1985. It is difficult to supply water reliably with these great variations in water supply, even in the rainy season.

The potential irrigated command area in the wet season was targeted to be 13,500 rai (2,160 ha). The actual irrigated area in the wet season was much less, averaging about 5,000 to 6,000 rai (800-960 ha). Dry season irrigated area was even smaller, commanding about 1,000-1,500 rai (160-240 ha).

Wet season water delivery starts in June and continues until November. The amount of delivery is approximately 2.0 million m^3/month. Water is also delivered in the dry season between January and April, averaging about 0.6 million m^3/month.

The Royal Irrigation Department (RID) constructed a 13.3-km right main canal and a 7.4-km left main canal. There are four concrete checks on the RMC (at km 0+650, km 3+500, km 6+100, and IL-RMC km 0+900). There are also two wooden checks made by farmers. One is located at RMC km 1+980 and one is at LMC km 1+850. In case of water shortage, the number of farmers' checks increases. Additional checks are usually located every 500 m in the head of the LMC and at km 5+100 on the RMC. The right main canal is lined for 9.1 km and the left main canal is lined for 5.5 km. Water rarely reaches the unlined sections of the main canals. The portion of the right bank canal beyond approximately 13.0 km has been abandoned and is now obliterated due to the sandy soils. In general, the physical condition of the RMC is much better than the LMC.

There were 27 turnouts along the left main canal, serving about 1,500 rai (240 ha), and 24 turnouts along the right main canal, serving about 4,500 rai (720 ha).[9] Farmers have made wooden gates to control the flow of water through the turnouts and have constructed farm ditches below the turnouts. These narrow earthen ditches follow property boundaries to minimize the land lost to cultivation.

Lam Chamuak soil textures are loamy sand to sand. The average percentages of sand, silt and clay are 67 percent, 25 percent, and 8 percent, respectively. These soils have low water retention and high permeability. The average pH of the soil is 6.6, with 0.9 percent of the soil being organic matter. The soil contained 0.06 percent total nitrogen, 0.08 ppm available phosphate, and 31 ppm available potassium. The soils are classified as vertic tropaquepts according to the USDA scheme and hydromorphic by the national scale.

Irrigated soils close to the Chamuak stream are on flat alluvial flood plains. The soils closer to the right and left main canals have slopes approaching one percent. The soils are medium to shallow in depth over a gray, semi-consolidated, impermeable substratum. Farmers complain that after drying, some of these soils become rock-hard. They refer to these soils as "elephant brains." In general, Lam Chamuak soils are marginally acceptable for irrigated agriculture.

B. WATER SOURCES AT LAM CHAMUAK

Most of the analysis in this report focuses on irrigation water from the Lam Chamuak canals. Although certainly a critical part of the farmers' water supply, canal water is not the only source of irrigation water. Farmers often employ more than one water source.

The type and number of water sources that a farmer uses helps to determine the farmer's water control. With more and better sources, farmers can apply the right amount of water to their crops at the right time. The following are the most important sources of irrigation water at Lam Chamuak.

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[9]RID plans to rehabilitate and improve the Lam Chamuak irrigation system. According to the new construction design, the total number of turnouts will be increased to 128 and about two-thirds of the existing irrigation structures will be changed. For example, the farm turnouts will be installed along the main ditches instead of the main canals, and the main and farm ditches will be no longer than 800 m. To increase the command area, the concrete-lined main canals will be lengthened. The lengths of the RMC and the LMC will be 14 km and 9 km, respectively. The number of water users will also increase.

1. Water Sources

Canal Water. The Lam Chamuak tank is a primary water source. Water flows through the two main canals and then into main or farm ditches. Farmers take water from the ditches and apply it to their plots.

When water supplies are low, some farmers place temporary checks in the main canal at night to raise the water level at the turnouts. Because of microtopography and land fragmentation, some farmers receive water from two or three turnouts to irrigate one plot of land. Still other farmers with fields adjacent or close to the main canals use pumps or siphons to draw water out of the main canals.

Pumping or siphoning water provides farmers with a great deal of water control since they can obtain water whenever there is water in the canal. While discussing the proposed rehabilitation of Lam Chamuak with RID officials, some farmers from the tail of the LMC stated that they would prefer to pump water from the main canal instead of receiving water from a main ditch. They also stated that if they did pump the water, they did not intend to pay the water fee collected by the WUA president.

Lam Chamuak Stream. Water from the Lam Chamuak River is stored in the Lam Chamuak tank. However, some of this water continues to flow through the middle of the command area in the Lam Chamuak river bed. Much of the water in the Lam Chamuak stream is irrigation drainage water. Though flows in the stream are sometimes very low, farmers often pump or siphon water from the stream to nearby fields.

"Mini-Scale" Irrigation Project. The Royal Thai government's Rural Income Generating Project has provided money for "mini" irrigation projects at Lam Chamuak and elsewhere since 1977. Of the 6,000 projects completed, approximately 50 percent of them are in northeast Thailand. At Lam Chamuak, two concrete weirs have been built across the Lam Chamuak stream to capture and use drainage water. Farmers dig their own ditches directly from these small reservoirs to their fields. Many of the farmers at the extreme tail of the system, who never receive water from the LMC or RMC, use water captured by these weirs.

RID and NESSI officials said that these "mini" irrigation projects within Lam Chamuak will be affected by the proposed rehabilitation. These officials predict that if a rotational water distribution system is instituted, less water will be available for the mini-scale projects. It is estimated that roughly 10 percent of the Lam Chamuak farmers rely on the water captured by the two weirs. To these farmers, this water is more reliable, more subject to control, and therefore, more valuable than canal water.

Natural Ponds. There are ten natural ponds within the Lam Chamuak command area, primarily along the tail portion of the RMC and at the extreme tail of the system. These ponds usually retain some water throughout the entire year. Farmers either pump water directly from the ponds or dig ditches from the ponds to their fields. During the dry season, farmers take water in buckets from the ponds to their vegetables. Ponds are important to farmers cultivating fields close to the ponds since the ponds often are their only reliable source of water.

Man-made Ponds. Farmers also dig their own small ponds to collect and store water. Later they dig farm ditches from the ponds to their fields or pump water to their fields. Farmers who do not crop in the dry-season keep some water in these farm ponds for domestic use and to raise fish.

Rain. Farmers also rely on rain, particularly to grow paddy in the wet season. The rains, however, are often erratic, and droughts are not uncommon.

2. Farmers' Use of Water Sources

Farmers often used more than one source. The research assistant observed that some farmers along the RMC heavily relied on rain and water from natural ponds. To complete their paddy transplanting, these farmers had to dig farm ditches from ponds to their paddy fields.

Though farmers at the tail and the extreme tail of the system were disadvantaged in terms of canal water, they did have access to natural ponds, the Lam Chamuak stream, and the "mini" project weirs. A farmer with access to all three of these sources could conceivably have an adequate and reliable supply of water even without canal water.

These additional water sources were not as convenient as canal water. To obtain water from such additional sources, a farmer had to own or rent a pump, or dig a ditch from the water source to his field. Also, only those farmers close to the weirs, stream, or ponds, had effective control of these sources.

Sample farmers were also asked about their primary water source during the paddy growing season. Table 15 reports the farmers' primary water sources during land preparation, transplanting, early growth, and flowering. The data show a general tendency for the LMC and RMC head farmers to rely on canal water. Farmers at the extreme tail reported that they depend on rain during these four stages of paddy growth. Table 15 indicates that no tail farmer at the LMC reported using canal water. While rain is certainly free, farmers have no control over its adequacy or reliability.

Sample farmers were asked what percent of their irrigation water comes from the Lam Chamuak canal in the wet and dry season (Table 16). Head farmers along the LMC and RMC reported that almost all of their irrigation water in the wet and dry seasons comes from the Lam Chamuak canals. Most tail and extreme tail farmers reported that a quarter or less of their irrigation water is supplied by the canals. Additionally, Table 16 indicates that farmers at the tail of the LMC have more difficulty receiving canal water than farmers at the tail of the RMC.

Table 15. Primary water source for paddy during different stages of cultivation as reported by sample farmers (by location).

Operation	LMC			RMC			Extreme
	Head	Middle	Tail	Head	Middle	Tail	Tail
	number of responses*						
Land Preparation							
Rain			4(44)		2(18)	4(50)	38(86)
Canal water	10(100)	6(86)		8(100)	9(82)	4(50)	
Rain & canal water			2(22)				
Canal water & natural pond water		1(14)					
Others			3(33)				6(14)
Not applicable		1					19
Transplanting							
Rain			5(56)			2(25)	35(80)
Canal water	10(100)	5(71)		8(100)	9(100)	5(63)	1(2)
Rain & canal water		1(14)	1(11)				1(2)
Natural pond water		1(14)				1(13)	
Others			3(33)				7(16)
Not applicable		1			2		19
Early Stage							
Rain			2(22)		1(9)	3(38)	36(82)
Canal water	10(100)	7(88)		8(100)	7(64)	3(38)	1(2)
Rain & canal water		1(12)	3(33)		2(18)	2(25)	
Others			4(44)				7(16)
Not applicable					1		19
Flowering							
Rain			4(44)		1(9)	3(38)	35(80)
Canal water	10(100)	8(100)		8(100)	9(82)	3(38)	1(2)
Rain & canal water			2(22)		1(9)	2(25)	1(2)
Others			3(33)				7(16)
Not applicable							19

*() = Percent of total responses from farmers at that location for that stage of growth, excluding "not applicable" responses.

Table 16. Percent of irrigation water received from Lam Chamuak canals in the wet and dry seasons (by location).

Season (%)	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail	Extreme Tail
	number of responses*						
Wet							
100	10(100)	5(63)		8(100)	6(55)	3(38)	
75		3(38)			3(27)		1(2)
50					1(9)	1(13)	1(2)
25			4(45)		1(9)	2(25)	
0			5(55)			2(25)	48(96)
Not applicable							13
Dry							
100	5(56)	1(20)		7(88)	6(67)	3(50)	
75							
50		2(40)				1(17)	
25	1(11)	1(20)		1(12)			
0	3(33)	1(20)	5(100)		3(33)	2(33)	21(100)
Not applicable	1	3	4		2	2	42

*() = Percent of total responses for that location, excluding "not applicable" responses.

Based on detailed case studies conducted throughout the system, the research assistant discovered that tail farmers depended on more unreliable water sources. The case study farmer at the LMC tail reported that in the wet season, 90 percent of his water for crops was from rain, and 10 percent came from pumping water out of the Lam Chamuak stream. This farmer said he usually used the stream water for seeding and to prepare land for paddy.

Case study farmers at the RMC head reported that they received water directly from the main canal or through other farmers' fields. Farmers with direct access to water in the main canal enjoyed a great deal of water control. Case study farmers at the RMC middle reported that their water source was canal water and rain. Some of the canal water passed through other farms, and some water was received from the farm ditch. One case study farmer at the tail of the RMC reported that 100 percent of his water came from rain while another farmer at the tail of the RMC stated that 90 percent of his water was from the Lam Chamuak canal.

C. RID AND FARMERS' ORGANIZATIONS

A RID provincial engineer in Korat has the ultimate responsibility for operating and maintaining RID irrigation systems in Nakhorn Ratchasima Province. A RID district O&M manager (called a water master in the past) is the highest-ranking RID official at Lam Chamuak. Below the district O&M manager is a zoneman, tank caretakers, and canal caretakers.

The zoneman is responsible for the overall maintenance of the tank. The zoneman also opens and closes the two gates on the tank, releasing water into the LMC and RMC. The tank caretaker is responsible for maintaining structures at the tank. If the zoneman is absent, the tank caretaker opens and closes the tank gates.[10]

Lam Chamuak also has RID canal caretakers who are responsible for smoothly operating and maintaining the main canals. After water has been delivered to the main canals, the caretakers are expected to patrol canals, remove illegal checks, and help farmers distribute the water throughout the system. The canal caretakers are the RID officials most familiar with Lam Chamuak farmers and their irrigation operations.

RID has recognized that farmers must play a role in system operations and maintenance. In an attempt to improve irrigation system performance, RID has tried to initiate the development of water user groups in irrigation systems. RID first initiated these groups in 1956 in Udorn Province, northeast Thailand. These water user groups, later called water user associations, were designed to serve as coordinating mechanisms between farmers and RID officials. They were supposed to create an improved understanding of water application, promote irrigated agriculture on major crops, assist with crop marketing and resolve water conflicts. RID informants stated that farmers have never felt a sense of ownership with regard to WUAs, and most WUAs have fallen into disuse. They usually exist in principle, but are not operative in the field.

RID established a WUA in Lam Chamuak in 1978. All farmers in the project command area were eligible to join. In 1985, 503 farmers were reported to be members, and approximately 100 farmers attended the annual meeting. When this study was conducted, the WUA had a chairman elected by members to a two-year term, a vice-chairman appointed by the chairman, a secretary, a cashier, and a receptionist (Figure 2).

When farmers require water, the chairman is expected to notify the RID provincial engineer through the tank caretaker or the district O&M manager. After approval by the provincial engineer, the district O&M managers ask the zoneman or the tank caretaker, to release water. The chairman also is to organize maintenance activities and to inform association members of irrigation rules and regulations.

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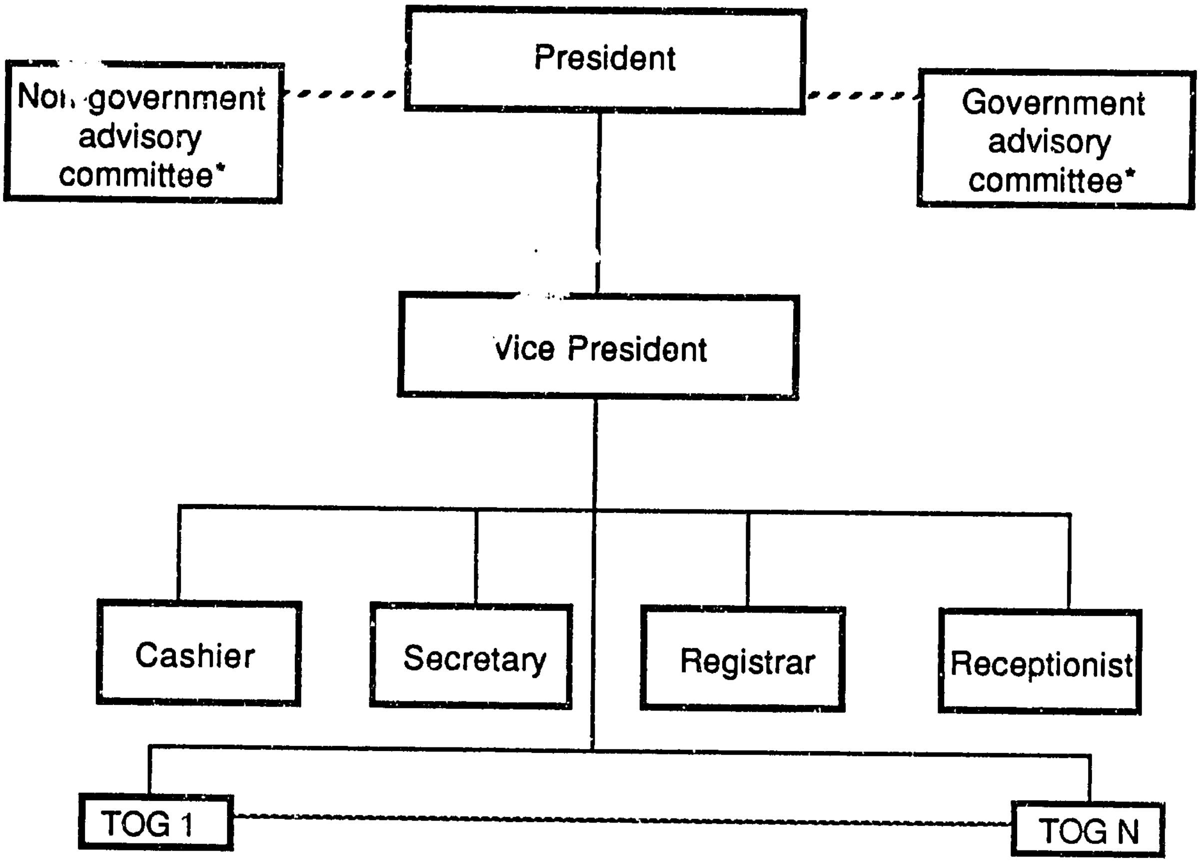
[10]When this study was conducted in 1986, the Lam Chamuak zoneman was an ICO at the site. His duties were those of an ICO, not a zoneman. The canal caretaker took over the zoneman's responsibilities. See Appendix A for details.



* The non-government advisory committee includes the head of the tambon (chair) and every village headman that benefits from the project (both outside and inside the command area). The government advisory committee includes the District O&M (chair) and other Lam Chamuak project (RID) employees.

Figure 2. Water users organization at Lam Chamuak, 1985-1986.

Farmers are asked to pay 20 baht ($.80) to join the association. Farmers receiving water are also asked to contribute 2 baht for each rai of land cultivated for association expenses. This money is deposited in the local Pimai District farmers' bank. At least two officers are required to be present to make withdrawals. In 1985, the chairman stated that he had not collected money recently because yields were low due to water shortages.

Each of the 51 turnouts along the two main canals is supposed to be managed by a turnout group (TOG) and a leader elected by farmers along that ditch, who is supposed to allocate water along that ditch. (Appendix E gives the rules set by farmers to regulate ditch operation and maintenance.) The number of farmers along each ditch varied from 2 to 24.

D. FARMERS OUTSIDE THE COMMAND AREA

There are farmers ("encroachers") who cultivate land outside of the originally designed command area, but who use water from one or more sources in the Lam Chamuak area. Over the years, these farmers have come to rely on Lam Chamuak water for their crops, and their use of water affects supplies for farmers in the command area.

1. Encroachers at the Tank

In the dry season, the water level in the Lam Chamuak tank decreases significantly and exposes land inundated during the wet season. Approximately 265 farm families were growing paddy in the dry sections of the tank bed in the dry season. They pumped water directly from the tank to irrigate an estimated 700 rai (112 ha), which included some vegetables for home consumption.

These farmers, from five nearby villages above the tank, came from two districts that have experienced severe droughts in the past few years. Spurred by subsequent low paddy yields, encroachers have gradually usurped dry parts of the tank bed since 1984.

The encroaching farmers have been relatively well organized. In four out of the five villages, farmers have established organizations to meet their basic needs for growing paddy. Each organization has a three to five-person farmer administrative committee, with the village headman acting as chairperson. Each committee tries to ensure that all members are able to grow some paddy in the dry part of Lam Chamuak tank.

The committees mark 1 or 2 rai (0.2 to 0.3 ha) plots with stakes. Each farm family then selects a parcel. Members of the administrative committee have the privilege of selecting their plots first, and they usually select land closest to the pumps.

The committees borrow 8-inch diameter pumps from the RID Provincial Irrigation Office in Korat. They collect money from group members for expenses in transferring the pumps from Korat to the Lam Chamuak tank, installing the pumps, and buying gasoline and diesel fuel for operation. The amount of cash collected varies from organization to organization. Each committee also arranges for and pays a group of persons to care for the pumps day and night.

The committees mobilize farmers to build small weirs at the shoreline to collect tank water. The weirs raise water levels in the lowest part of the encroached areas. Water pumped into watercourses constructed by the farmers is then delivered to the irrigated areas.

The committees obtain fertilizer and pesticides from the district Agricultural Extension Office and distribute them to their farmers at no cost. New members, however, are expected to bring local paddy seed to exchange for improved paddy varieties. Improved paddy varieties are usually ready for harvest earlier than local varieties. Committee members frequently communicate with government officials and seek advice from RID and local agricultural extension workers. Each of the four organizations set their own rules for water distribution, and members appear to accept a close connection between contributing to the organization and obtaining water.

Considering that the paddy is grown in the dry season, yields are relatively high, averaging 320 kg to 600 kg per rai (2.0 mt/ha - 3.75 mt/ha). Soil conditions are very favorable for paddy cultivation.

However, the encroaching farmers face some unique problems:

1. Farm sizes cannot be expanded, particularly in the upper reaches of the encroached area.

2. The size of the allocated plots becomes smaller as the number of farmers increases.

3. Farmers lack capital to expand farm sizes by purchasing a bigger pump or raising watercourse levels.

4. The 8-inch diameter pump leading to each organization's land is too small to distribute water adequately to every farm.

5. Paddy has to be harvested before the water level in the tank increases significantly in the beginning of the wet season.

To overcome some of these problems, the encroaching farmers have sought outside help. In 1986, the Royal Thai Government's Rural Income Generating Project allocated some money to the encroaching farmers' local administrative unit. The money was intended to help these farmers build an improved canal from the water in the tank to the tank bed plots and to the fields that the farmers own outside of the encroached area. The farmers contributed some money to help with the canal construction. The farmers were also expected to contribute labor for rehabilitating their farm ditches.

Using this money, the local administrative unit organized the farmers to help construct a 1.8-km main canal and a 910-m sublateral canal. The main canal was concrete-lined for 600 m. It was expected that by pumping water from the Lam Chamuak tank into the main canal and sublateral, a total of 2,900 _rai_ (464 ha) could be served: 1,200 _rai_ (192 ha) in the encroached area and 1,700 _rai_ (272 ha) outside the encroached area.

There were no reported conflicts between encroaching farmers and farmers cultivating below the tank. Farmers below the tank may not feel threatened by the encroaching farmers because their water use does not greatly interfere with the farmers below the tank, who do not use much irrigation water during the dry season when the encroaching farmers grow their paddy.

RID officials are not sure how to deal with the encroaching farmers. They admit that according to the law, the encroaching farmers should not be allowed to farm in the tank bed or to convey tank water to the fields they own outside the tank. Nevertheless, encroaching farmers have been farming the tank bed using Lam Chamuak water since 1984, and they have the sympathy and support of local administrative leaders. Indeed, since the RID Provincial Irrigation Office in Korat has loaned pumps to the farmers for the past few years, they have created a precedent for continuing this practice every year.

RID officials have stated that growing paddy in the dry tank bed could lead to siltation and operation and maintenance problems in the command area below the tank. Some NESSI officials have suggested that the encroaching farmers should be made members of the Lam Chamuak WUA so that the dry season use of tank water can be controlled.

The encroaching farmers realize that growing crops in the dry tank bed is considered usurpation. They also realize that they have nothing to gain from the rehabilitation of the Lam Chamuak Project since the farms they own are outside the command area. Nevertheless, they want to continue to use Lam Chamuak water to grow crops in their fields beyond the dry tank bed. They had some specific requests regarding continued usage:

1. They would like continued help from RID officials in managing the "irrigation system" in the encroached area, and they want more pumps for each organization and fuel for operating the pumps.

2. They would like to use Lam Chamuak tank water for both dry and wet season cropping, particularly when drought occurs.

3. They would like RID assistance in constructing another canal of 600 m, concrete-lining all 1,800 m of their old main canal, and building a reservoir (40 m x 40 m x 4.5 m).

4. They would like RID to disseminate information about effective water users' groups and irrigation water use.

2. Farmers at the Tail and Extreme Tail

About 15 farmers near the tail of the LMC and the extreme tail of the RMC routinely pump water from the LMC when water is available. These farmers irrigate approximately 305 rai (49 ha) that are not in the originally designed command area. They have been informally organized for about three years.

These farmers help Lam Chamuak farmers maintain the canals. For example, in early August 1986, ten of these farmers removed weeds around turnouts 23 and 24 of the LMC. About eight farmers removed silt from portions of the LMC.

These few farmers from outside the command area know that they are not supposed to pump water from the main canal. They have asked RID officials if they would be allowed to continue pumping if they contributed labor for system rehabilitation. Although no formal decision has been made, RID officials have informally stated that Thailand's irrigation law prohibits farmers outside the command area from pumping from the main canal. Therefore, RID cannot officially approve this behavior.

Irrigation community organizers working to strengthen the Lam Chamuak WUA and TOGs have suggested that these farmers select a group chairperson and vice-chairperson. These officials could then negotiate with the leaders of the tail turnouts on the LMC for opening and closing the turnouts.

Tail and extreme tail farmers outside the command area have stated their desire to continue using Lam Chamuak water for paddy cultivation, particularly during seed bedding, transplanting, and when the rains are late. They feel that water could come from either the main canal or from the drainage system. They also expressed a desire to become active members of the Lam Chamuak WUA.

V. WATER ALLOCATION, MAINTENANCE, CONFLICT MANAGEMENT, AND THE WUA

The discussion turns now to a description of how RID and the farmers organize to allocate water, maintain the system, and manage conflict. This chapter concludes with a brief analysis of the Lam Chamuak water users' association.

A. WATER ALLOCATION AND DISTRIBUTION

1. On the Main System

At the beginning of the wet season, RID is supposed to release water from the tank in accordance with the farmers' wishes. In 1985 (wet season), water was delivered to the two main canals from June 15 to October 31, and then again from November 18 to 26. In 1986 (wet season), water was delivered from July 1 to November 30. These dates roughly corresponded to the farmers' irrigation needs.

The water release procedure followed in the 1986 wet season was typical. The president of the WUA wrote a letter to the provincial engineer in Korat stating when the WUA members would like to have water delivered. He delivered the letter to the district O&M manager at Lam Chamuak. The provincial engineer approved the request and the District O&M assigned the tank caretaker to open and close tank gates.[11] The tank caretaker assigned the canal caretakers to try to control water flowing into the turnouts and farm ditches from the main canals. The canal caretakers were also asked to follow the water, and to increase or decrease the water level in the main canals when they felt it was appropriate.

Throughout the wet season, the water was delivered continuously in the two main canals. Wooden check structures along the RMC and LMC allowed system-wide water rotation. Farmers and RID officials used these wooden boards to check the water in the main canals and to deliver water into a particular turnout. These temporary boards were the only allocation tools employed along the main canals.

During periods of acute water shortages, some strong TOG leaders instituted a rotational system of water allocation along the main canal for a few of the turnouts. The leader of TOG 15 on the RMC, for instance, would arrange with the leaders of TOGs 16 and 17 to take water from the main canal for one day, and then let the water pass on to turnouts 16 and 17 the next day.

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[11] Normally, the zoneman would open and close the gates, but in 1986 the Lam Chamuak zoneman was working as an ICO at Lam Chamuak.

At times, RID temporarily stopped water delivery or decreased the water level in the canals due to unplanned circumstances, such as heavy rain, severe canal damage, severe water shortage in the tank, a request to RID from the president of the WUA, or an emergency order from the provincial engineer.

In August 1986, water delivery from the tank was occasionally disrupted. For example, on August 5, RID demonstrated a special water delivery technique which required that water delivery be interrupted for one day. During heavy rains on August 11-12, water deliveries from the tank to the RMC were stopped. Due to heavy rains and the necessity of making canal repairs, water deliveries were stopped on the RMC on August 5, 22, and 23, and on the LMC on August 5, 11, and 12.

During the dry season, fewer farmers were engaged in irrigated or non-irrigated agriculture than during the wet season. Nevertheless, a similar procedure for water release was followed. In the 1985 dry season, water was delivered to the two main canals from February 15 to March 15. In the 1986 dry season, the president of the WUA requested water from RID for approximately 1,000 rai (160 ha). RID officials started to deliver water to both the RMC and LMC on January 24, 1986. Water deliveries were stopped along the LMC on February 5 and along the RMC on February 14.

These water allocation procedures were not well known among the Lam Chamuak farmers. Table 17 reports data regarding the knowledge level of the farmer informants. It was expected that such informants would be relatively well-informed about main system water allocation procedures; however, they were not.

Over a third of the key informants said that they did not know who scheduled water releases from the tank (Table 17). Only one-third knew that the WUA president was a key figure in scheduling releases.

Two-thirds of the informants said they did not know who opens the tank gates to begin water delivery, and the other one-third of the farmers answered the question incorrectly. (Normally, the RID zoneman is responsible for opening the tank gates, but in 1986, the tank caretaker opened the gates and started water delivery.) Finally, almost three-quarters of the informants said that they did not know who stops water delivery.

Table 18 reports data gathered from the 117 sample farmers, which indicate that they lack knowledge of, or interest in, main system water allocation. All sample farmers were asked where they received information regarding the opening and closing of the tank gates. All 63 sample farmers at the extreme tail replied that the question did not apply to them, as they never received canal water and were not concerned with such information.

Table 17. Knowledge of farmer informants regarding main system water allocation and distribution procedures, Lam Chamuak.

Questions and Responses	Frequency of Responses*
Who schedules tank releases?	
WUA president	11 (34)
TOG leader/assistant	4 (13)
RID official	3 (9)
Farmer	2 (6)
Do not know	12 (38)
What criteria are employed for water delivery?	
Farmer demand	17 (53)
RID criteria	1 (3)
Do not know	14 (44)
Who opens tank gates to begin water delivery?	
TOG leader/assistant	10 (31)
WUA president	1 (3)
Do not know	21 (66)
Who stops water delivery?	
TOG leader/assistant	7 (22)
WUA president	2 (6)
Do not know	23 (72)

*() = Percent of total responses for that question.

A large number of the 54 sample farmers along the LMC and RMC also said that the question did not apply to them. The pattern that emerges in Table 18 reports data indicating that head farmers along the LMC and RMC and a few middle farmers obtain water allocation information from the WUA president, who lives at the head of the system.[12]

Observations by the research assistant confirm that the WUA president was active at the head of the system. The research assistant also reported that the WUA president tried to travel to other parts of the system, but since he had no transportation, it was difficult for him to visit all parts of the system.

The large number of farmers at the tails of both the LMC and RMC who stated "not applicable" indicates that water deliveries at the

[12]Another factor to consider: The WUA president is Thai Esan, as are most of the Thai Esan farmers at the head of the system.

tail are unreliable and infrequent. Therefore, these farmers may have no interest in obtaining information about tank gates. Throughout the tables in this report, almost all of the sample farmers at the extreme tail replied "not applicable" to the question discussed. **These responses are not listed in the tables.**

Sample farmers were also asked if they are allowed to request more water if they need it. Table 19 reports that a few farmers (primarily from the head of the LMC) said that they could request additional water in the wet season. However, most of the 54 LMC and RMC farmers replied that they cannot request additional supplies (Table 19).

Table 18. Sample farmer sources of information about tank schedule (by location).

Question and Response	LMC			RMC			Extreme
	Head	Middle	Tail	Head	Middle	Tail	Tail
	number of responses*						
Who opens tank gates?							
WUA president	5(63)	4(100)		6(100)		2(67)	
Government official	1(13)				1(50)	1(33)	
Farmer friend	1(13)				1(50)		
Village headman	1(13)						
Not applicable	2	4	9	2	9	5	63
Who closes tank gates?							
WUA president	7(100)	4(100)		6(100)			
Government official						1(100)	
Farmer friend					1(100)		
Village headman							
Not applicable	3	4	9	2	10	7	63

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

Table 19. Farmers' rating of their ability to request additional water in the wet season (by location).

	LMC			RMC		
Frequency	Head	Middle	Tail	Head	Middle	Tail
	---number of responses*---					
Always	1(10)				1(10)	
Often	2(20)					
Sometimes	1(10)		1(14)	1(13)		2(33)
Seldom	1(10)			2(25)		1(17)
Never	5(50)	7(100)	6(86)	5(63)	9(90)	3(50)
Not applicable		1	2		1	2

*() = Percent of the total number of responses from sample farmers at that location, excluding "not applicable" responses.

In the dry season, even fewer farmers said that they could request supplementary water. Only 6 (13 percent) of the 45 sample farmers who replied said that they can request more water (not shown in a table). The data for both the wet and dry seasons indicate that, except for a few farmers at the head of the system, Lam Chamuak farmers believe that they have little control over water allocation.

Table 20 shows sample farmer responses to the question "What do you do when you need water?" The responses indicate that most head farmers and some middle farmers talk to the WUA president, while the rest of the farmers tend to do nothing.

Table 20. Farmer behavior when needing more water (by location), Lam Chamuak.

	LMC			RMC		
	Head	Middle	Tail	Head	Middle	Tail
	---number of responses*---					
Contact:						
WUA president	9(90)	5(63)	1(17)	5(63)		1(17)
RID officials		1(13)			1(9)	1(17)
TOG leader				1(13)	1(9)	
Do nothing, wait	1(10)	2(25)	5(83)	2(25)	9(82)	4(67)
Not applicable			3			2

*() = Percent of the total number of responses from sample farmers at that location, excluding "not applicable" responses.

Since the WUA president lives at the head of the system with other Thai Esan, it was not surprising to find head farmers relying on the WUA president to help them with their water allocation problems. Other farmers, however, did not appear to have adequate linkage.

Most head and middle farmers were satisfied with water deliveries at Lam Chamuak (Table 21). However, dissatisfaction was evident at the tail of the system, where at least half of the farmers reported that they were completely dissatisfied with the water delivery system. Therefore, dissatisfaction is strongly related to location.

Table 21. Farmer satisfaction with water delivery system, Lam Chamuak.

Degree of Satisfaction (%)	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail
	-----	-----	number of	responses*	-----	-----
100	7(70)	4(50)		7(87)	5(45)	4(50)
75	1(10)	2(25)			1(9)	
50		1(13)			2(18)	
25	1(10)	1(13)	1(13)		1(9)	1(13)
0	1(10)		7(87)	1(13)	2(18)	3(38)
Not applicable			1			

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

2. On the TOGs and Farm System

After water passes from the main canals into the 51 turnouts leading to the main and farm ditches, RID authority ceases and farmers control water allocation and distribution. In the wet season, no system-wide water distribution system exists below the turnouts. Typically, TOG members receive water whenever it is convenient for them, especially when water is abundant in the main canals. Many TOGs had no schedule of water delivery; they simply let each farmer along the ditch procure water whenever he could. Some farmers along a ditch receive water at the same time.

The key farmer informants were asked about allocation procedures along the farm ditches. Data in Table 22 indicate that no commonly accepted rules for allocation existed. The most frequent response regarding how water is allocated along farm ditches was "do not know." These responses may indicate the diversity of procedures along each ditch, rather than a lack of knowledge. Respondents were unable to describe one overall water allocation procedure for all of the main and farm ditches.

The research assistant at Lam Chamuak noted that no one, and everyone, is responsible for opening and closing the turnout "gates" along the main canal. He observed that whoever wanted or needed water the most allowed water to flow through the main and farm ditches.

Sample farmers were asked if there was a water delivery schedule among TOG members on their ditch. Most sample farmers had not agreed to a establish a water delivery routine along their ditch (Table 23). It is possible that sample farmers were confused about what was meant by "water delivery schedule." One farmer may have interpreted this to mean a signed document and another farmer on the same ditch might consider it an informal agreement. In any case, the data show that only a few farmers in each location said that their TOG had a schedule for water delivery.

Table 22. Farmer informants' knowledge of water allocation procedures at turnout level.

Question and Response	Frequency of Responses*
What is the criteria for water delivery along ditches?	
Farmer demand	2 (8)
No criteria	1 (4)
Do not know	21 (88)
Who opens turnout "gates" to deliver water to ditch?**	
TOG leader/assistant	4 (17)
Do not know	20 (83)
Who stops water delivery?	
Farmer water users	6 (35)
TOG leader/assistant	3 (18)
Do not know	8 (47)

*() = Percent of total responses for that question.
**The "gates" are actually boards, weeds, or other debris used to block the turnout.

Table 23. Sample farmers' responses regarding the presence of a water delivery schedule along farm ditches (by location), Lam Chamuak.

Is there a water delivery schedule on the farm ditch?	LMC			RMC		
	Head	Middle	Tail	Head	Middle	Tail
	number of responses*					
Yes, by agreement.	2(20)	2(25)	2(29)		1(9)	2(29)
No, but receive water anyway.	8(80)	6(75)	5(71)	8(100)	10(91)	5(71)
Not applicable.			2			1

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

The research assistant reported, however, that some TOGs instituted rotational water deliveries along their ditches during periods of water shortage. Some TOGs let the tail farmers on the ditches receive water first; others allocated water to the head farmers first. TOG leaders were primarily responsible for instituting and enforcing the particular TOG's allocation rules.

Sample farmers were also asked where they received information about the schedule of water releases from the turnout (Table 24). A variety of information sources were used, reflecting the different arrangements for water allocation along each ditch.

Table 24. Sources for information about schedule of water releases from the turnout (by location).

Source of Information	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail
	number of responses*					
WUA president	5(83)	2(40)		2(50)		
Farmer friend	1(17)	2(40)	1(50)		3(75)	
TOG leader		1(20)		2(50)		2(67)
Government official			1(50)		1(25)	1(33)
Not applicable	4	3	7	4	7	5

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

Data in Table 24 indicate that a comparatively large percentage of farmers at the head of the system rely on the WUA president to provide information on water releases. It appears that the Thai Esan (located at the head of the system) use the WUA president as an information source more often than the Thai Korat (located in the middle and tail of the system).

Whatever the allocation procedure or information source, usually some farmers along a ditch received water before other farmers. Sample farmers were asked who first received water along their ditches (Table 25). There is a diversity of responses in this table, reflecting that TOGs allocated water differently. Indeed, along one ditch, allocation procedures changed from season to season, week to week, or day to day. No one method of water allocation prevailed.

Table 25. Sample farmers report of who first receives water (by location).

Farmers Receiving Water First	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail
	number of responses*					
Head farmers	3(30)	1(13)	2(29)	3(38)	6(55)	4(57)
Tail farmers	3(30)	2(25)				1(14)
All receive at same time	2(20)	2(25)	1(14)	2(25)	2(18)	1(14)
No definite schedule	2(20)	3(38)	4(57)	3(38)	3(27)	1(14)
Not applicable			2			1

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

Farmers expressed preferences for different water allocation procedures along ditches. Almost all farmers were dissatisfied with receiving water along the ditch at the same time (continuous flow). Conversely, most farmers at all locations were satisfied with receiving water along the turnout by informal rotation (Table 26).

Additionally, farmers expressed dissatisfaction with a fixed schedule. Farmers were interested in predictable and controllable water delivery.

Some TOGs at Lam Chamuak began the irrigation season with a rotational water delivery system, but later changed that schedule. For instance, TOGs 4, 9, and 21 on LMC rotated water delivery during the 1986 wet season. At the end of August 1986, however, TOG 9 abandoned its rotational system of water delivery. The members of TOG 9 were no longer interested in the rotational schedule because they wanted to finish transplanting paddy as soon as possible, and the TOG 9 leader was not able to enforce the TOG rules. This ultimately led to conflict among the TOG members.

Table 26. Farmer preference for different methods of water allocation (by location), Lam Chamuak.

Degree of	LMC			RMC		
Satisfaction (%)	Head	Middle	Tail	Head	Middle	Tail
	---------------number of responses*-----------					
Receiving water along ditch at same time						
100		1(13)		2(25)	3(27)	1(14)
75	1(10)	1(13)				
50		1(13)	1(14)	1(13)		1(14)
25		3(38)			1(9)	
0	9(90)	2(25)	6(86)	5(63)	7(64)	5(45)
Not applicable			2			1
Receiving water along ditch by informal rotation						
100	8(80)	3(38)	6(86)	5(63)	9(82)	6(75)
75	1(10)	3(38)				
50		1(13)	1(14)	2(25)	1(9)	
25		1(13)				2(25)
0	1(10)			1(13)	1(9)	
Not applicable			2			
Receiving water along ditch, but not on fixed schedule						
100	1(10)	2(29)		2(25)	1(9)	2(25)
75	1(10)					
50		1(14)				
25	1(10)	1(14)			1(9)	
0	7(70)	3(43)	7(100)	6(75)	9(82)	6(75)
Not applicable		1	2			

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

Farmers along TOG 4 and TOG 21 continued to maintain a rotational system of water delivery. These farmers reported that they cooperated with one another because their TOG leaders were well respected by all members.

In almost all turnouts, tail farmers said that they did not receive adequate or timely water. Farmers attributed this to design and construction problems (such as poorly aligned turnouts in the main canal) and farmers at head locations taking too much water.

Farmers along head and middle ditches reported that they were generally very satisfied with water allocation (Table 27). However, approximately half of the sample farmers along the tail ditches said that they were entirely dissatisfied with water allocation along the ditch. Though each TOG had its separate character, rules, and allocation procedures, the data in Table 27 indicate that water allocation procedures deteriorated from head to tail along the entire system and were related to decreasing farmer satisfaction with allocation along the ditches.

Table 27. Farmer satisfaction with water allocation along ditches (by location), Lam Chamuak.

Degree of	LMC			RMC		
Satisfaction (%)	Head	Middle	Tail	Head	Middle	Tail
	---number of responses*---					
100	2(22)	4(67)	2(33)	5(63)	6(67)	2(25)
75	7(78)	2(33)	1(17)	2(25)	1(11)	2(25)
50			1(17)			
25						
0			2(33)	1(13)	2(22)	4(50)
Not applicable	1	2	3		2	

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

Among the farmers who grew crops during the dry season, there were even fewer widely accepted TOG rules for water allocation than in the wet season. As in the wet season, each TOG set its own rules. Some TOGs gave priority to farmers along the head of the ditch, and others gave priority to tail farmers. Some TOG members received water simultaneously along the same ditch due to the small number of dry season irrigators. Members of other TOGs received water whenever water was available by requesting supplies from the TOG leader.

The agricultural extension employee worked with forty-three farm families in a dry season pilot project for vegetable production. These farmers received water on rotation from TOG 5 on the RMC. The agricultural extension individual worked with RID to ensure that a reliable supply of water reached these farms. On the average, each farm received water once a week. The farmers who bypassed their turn had to wait for the next round. Those who took water when it was not their turn were fined 50 baht ($2.00) by the TOG. There were few reports of violators at the pilot project.

3. Conclusion

Farm location on the system does relate to water allocation. Thai Esan, including the WUA president, live at the head of the system. Head farmers seem to rely heavily on the WUA president for water allocation information and communication with RID. The tail and extreme tail farmers (Thai Korat), however, seem to have lost interest in many water allocation issues. It seems that these farmers are receiving unreliable, inadequate, or no water. They appear to have been disfranchised by the system.

Farmers appear to lack knowledge about allocation procedures. The apparent lack of knowledge and the many "I don't know" responses do not necessarily indicate authentic lack of knowledge. Inability to answer questions about the system can be attributed to some degree to lack of interest in a system which delivers poor service to many, rather than to lack of knowledge.

However, farmers genuinely do lack knowledge regarding water allocation procedures due to defects in both the physical and organizational structures at Lam Chamuak. For example, farmers and RID officials must wrestle with wooden planks and weeds to control water on the main canals. It is difficult to institute effective water allocation procedures, which would raise levels of knowledge and interest, under those circumstances.

Additionally, there is a lack of coordination between the farmers and local RID officials, and there is no effective mid-level mechanism functioning between RID and the farmers that could improve water allocation and distribution. An organizational skeleton does exist at Lam Chamuak in the form of the WUA and the TOGs. However, the WUA and the TOGs were not operating well enough to effectively allocate water.

B. MAINTENANCE

1. On the Main System

Each year the provincial irrigation office receives a budget for main system maintenance on all the RID irrigation systems in the province, including Lam Chamuak, and a budget for emergency canal repairs. RID officials at Lam Chamuak stated that their biggest maintenance problem was sedimentation in the main canals.

Farmers claimed that the LMC was too narrow and the slope was too great. They reported that water flowed past their turnouts too fast to be captured. Though both the RMC and the LMC have broken banks, sloughed sides, and considerable sedimentation, the condition of the RMC was markedly better than the LMC

RID canal caretakers are responsible for removing weeds from their specific sections along the main canals. On the LMC, three canal caretakers are each responsible for 2.5-km sections. On the RMC, the four caretakers are each responsible for 2.3-km sections. The canal caretakers do not work at the extreme tail of the system, where the canals have fallen into total disrepair and farmers have never received canal water.

Major main canal maintenance is done in May and June, just before wet season irrigation begins. Though routine maintenance work on the LMC and RMC is RID's responsibility, farmers are often recruited to help remove weeds and sediment from the canals. In May 1986, RID officials at Lam Chamuak hired 15 farmers to make spot repairs of the concrete lining along the LMC and RMC. Along the head of the RMC (at km 1+980), the TOG 5 leader and three TOG 5 members helped RID repair the canal embankment without being paid.

Local RID officials maintain the lined portions of the canals as best they can. In August 1986, heavy rains and inflows damaged the LMC embankment. RID officials used an emergency budget to hire a few farmers to help repair specific sections of the LMC.

During a water shortage in October 1986, RID officials encouraged farmers to save water. A number of farmers from the head and a few farmers from the tail of the system mobilized enough labor to construct a temporary earthen weir across the Lam Chamuak stream at the head of the system to save water.

Both RID officials and local leaders have organized main canal maintenance (Table 28).

Table 28. Farmer informant report of who initiates main canal maintenance.

Who Initiates Maintenance	Frequency of Responses*
WUA president	10(24)**
TOG leaders	10(24)
Village headmen	8(19)
Head of <u>tambon</u> (local administrative unit)	4(10)
RID officials	3(7)
TOG members	2(5)
WUA committee	1(2)
Do not know	4(10)

*Multiple responses allowed.
**() = Relative percent of total responses.

Table 29 reports where sample farmers receive information on the maintenance schedule. As in Table 28, the responses are scattered, showing little pattern.

Table 29. Sources of information about maintenance schedule (by location).

Information Sources	LMC			RMC		
	Head	Middle	Tail	Head	Middle	Tail
	number of responses*					
Farmer friend	3(38)	4(67)	6(100)	3(60)	5(71)	3(60)
WUA president	5(63)	1(17)		1(20)		
TOG leader		1(17)		1(20)	1(14)	2(40)
Village headman					1(14)	
Not applicable	2	2	3	3	4	3

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

Unlike water allocation procedures, location does not play a large part in determining who initiates maintenance activities and provides maintenance schedule information. For instance, while the WUA president's role at the head of the system in maintenance activities is apparent in Tables 28 and 29, his role was not nearly as prominent as it was in water allocation. It appears that maintenance responsibilities are shared among a great number of people.

The research assistant reported that when labor was short for canal cleaning, the WUA president mobilized labor from different parts of the system. In August 1986, for instance, the WUA president mobilized farmers along both main canals to remove the silt in front of each turnout to permit an improved flow of water.

Farmer informants reported that farmers work on the main canals -- sometimes with RID officials and sometimes by themselves -- at least once or twice before or during the wet season. They also reported that when such main canal maintenance is done, it usually requires one or two days.

Sample farmers were asked about the frequency and duration of their participation in main canal maintenance during the wet season. Though their responses in Table 30 are fragmented due to the large number of "not applicable" responses, these data indicate that farmers participated in these activities about once a year for one or two days.

Some tail farmers may spend time cleaning more often because they receive just enough water to make it worth their time to periodically clean the main canal. Though many tail farmers have lost interest in water allocation issues, they do seem slightly more interested in maintenance activities. Of course, farmers at the extreme tail did not clean the canal since they do not receive water in any amount.

Table 30. Frequency and duration of sample farmers' participation in main canal maintenance during the wet season (by location).

	LMC			RMC		
	Head	Middle	Tail	Head	Middle	Tail
	----------------number of responses*----------------					
Frequency of participation						
Never	1(25)					2(29)
Seldom	1(25)		1(20)		1(25)	
Once	2(50)	2(100)	2(40)		3(75)	4(57)
Twice			2(40)			1(14)
Not applicable	6	6	4	8	7	1
Duration of cleaning (days)						
0			1(20)			1(14)
1	3(100)		3(60)		2(50)	1(14)
2		2(100)			1(25)	2(29)
3					1(25)	1(14)
4						1(14)
5			1(20)			1(14)
Not applicable	7	6	4	8	7	1

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

Table 31 indicates that most sample farmers expressed satisfaction with the cleaning of the main canal. Nevertheless, there is a general trend towards dissatisfaction as one moves from the head to the tail, particularly on the LMC. While tail farmers clean the main canal, they express more dissatisfaction with the cleaning.

Table 31. Sample farmer satisfaction with main canal maintenance (by location).

Degree of	LMC			RMC		
Satisfaction (%)	Head	Middle	Tail	Head	Middle	Tail
	------------------number of responses*------------					
100	2(40)	2(29)	3(50)	1(33)	6(60)	4(57)
75	3(60)	5(71)		2(67)	3(30)	2(29)
50					1(10)	
25		1(14)				1(14)
0			3(50)			
Not applicable	5		3	5	1	1

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

The research assistant observed farmers participating in main canal cleaning during the 1986 wet season. He reported that 318 farmers -- males and females, married and single, landowners, tenants, relatives of landowners, and hired laborers -- helped clean the main canals. Their ages ranged from 14 to 60. Some farmers had joint agreements concerning maintenance. Females participated if the male in the family did not want to participate, did not reside at Lam Chamuak, or was too old to participate. At least one person from each household receiving water from Lam Chamuak project is supposed to participate in maintenance. Exceptions are made if a farmer is ill or has other business of importance. If a water user cannot participate in maintenance, he can ask a family member to represent him or he can hire labor. Laborers were paid 30 baht ($1.20)/ day.

Farmers who did not participate because they had business in the city were asked to contribute food or liquor to the farmers working on the canal. Most of the key farmer informants said that they never need to impose punishment for non-participation. Some farmers reported that they participated in maintenance because they wished to avoid negative village "gossip."

Each TOG was assigned a length of canal to clean, and every TOG member worked on their section until it was finished. Each group cleaned their respective sections of the main canal. A TOG with a small number of members had to clean the same length of main canal as a TOG with more members. While the TOG with fewer members might take four days to clean their section of canal, the TOG with more members might finish in two or three hours. Some farmers ventured the view that this practice was unfair.

The research assistant observed that from June 17-19 and from June 24-25, 1986, farmers from all the TOGs on the LMC helped RID clean the left main canal. On June 19, 1986, farmers from TOGs 1 to 7 on the RMC cleaned their section of the right main canal. From June 10 to 11 and from June 29 to 30, farmers from the tail TOGs of the RMC (19-24) cleaned the main canal of sediment and weeds. The research assistant also reported that some farmers at the head of the system (who receive ample supplies of canal water) rarely participated in main canal cleaning.

Farmers at the extreme tail of the system (who never receive canal water) did not participate. The lone exception to this rule was the president of the local farmers' cooperative. Though farming at the extreme tail, he did participate in cleaning the main canal.

On their own initiative, some farmers have improved the main canal. They have constructed small, free-standing bridges from tree trunks and placed them across the main canals for cattle and water buffalo to use. They have prohibited cattle and water buffalo from walking or lying in the main canal and prohibited vegetable gardening along the main canal embankment. Though the farmers have not successfully stopped cattle from getting into the canals, they have reduced the prevalence of vegetable gardening on the embankments. Despite their efforts, sediment is still a problem in the main canal.

2. Turnout and Farm Level Maintenance

Farmers have complete responsibility for cleaning their main and farm ditches. Key farmer informants were asked who initiated ditch cleaning. Table 32 indicates that TOG leaders and regular members initiate ditch cleaning. However, a third of the key informants reported that they did not know who organized collective cleaning.

Table 32. Farmer informant reports of who initiates TOG ditch maintenance.

Who Initiates Maintenance	Number of Responses*
TOG leader	15 (43)
TOG members	8 (23)
Village headman	1 (3)
Do not know	11 (31)

*() = Percent of total responses.

Note that the WUA president was not mentioned as an initiator of ditch cleaning. In his capacity as a TOG leader, however, he mobilized farmers at the head of the system to remove sediments and weeds along two farm ditches.

The WUA president also appeared to play a vital role in system-wide ditch maintenance during emergencies. For instance, the research assistant reported that in October 1986, during a severe water shortage in the Lam Chamuak tank, the WUA president mobilized labor to clean farm ditches so that the restricted water supply could reach the paddy crop during the critical flowering stage.

Most farmers at all locations cleaned their TOG ditches of sediment, weeds, and debris at least once or twice in the wet season (Table 33). Most farmers in all locations reported that cleaning takes one to three days.

During TOG ditch maintenance, food and drink were provided in the same way as for main canal maintenance. The division of labor and agreements were also the same. Some TOGs, however, did not enforce their agreements. At these locations, farmers who felt the most need for water cleaned the necessary portion of the ditch on their own. Other TOGs, particularly those with strong TOG leaders, were strict in requiring all farmers along the ditch to provide labor for maintenance. Leaders from these TOGs kept meticulous records of who contributed labor.

Table 33. Frequency and duration of sample farmers' participation in ditch maintenance during the wet season (by location).

	LMC			RMC		
	Head	Middle	Tail	Head	Middle	Tail
	-number of responses*-					
Frequency of Participation						
Never			1(25)	1(17)		1(14)
Once	5(71)	6(100)	2(50)	4(67)	5(71)	4(57)
Twice	2(29)		1(25)	1(17)	2(29)	2(29)
Three times	1(14)					
Not applicable	2	2	5	2	4	1
Duration of Cleaning (days)						
0	2(22)			2(33)	1(14)	1(17)
1	4(44)	2(33)	2(100)	3(50)	3(43)	1(17)
2	1(11)	2(33)		1(17)	1(14)	1(17)
3	2(22)				1(14)	3(50)
4		1(17)				
5		1(17)				
7					1(14)	
Not applicable	1	2	7	2	4	2

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

TOG 21 on the right main canal, for instance, stressed strict rule enforcement. In June 1986, the TOG leader called a meeting of farmers along the turnout and set a maintenance schedule. He also reminded the members of the rules they had agreed to in the April TOG meeting. At that meeting, the TOG members had decided that farmers who worked only half a day would be considered absent. After the first maintenance activity in June, 14 members had been fined 30 baht ($1.20) per day for not participating, or they had agreed to provide labor for the next maintenance activity.

Note that TOG 21 is at the tail of the RMC. Despite its disadvantageous location, a serviceable main canal and a strong TOG leader who demands compliance with mutually agreed upon rules combine to produce a well-maintained farm ditch. Location, therefore, can be overcome with the proper physical facilities, leadership, rules, and organization.

Sample farmers were asked about their satisfaction with the cleaning of their main and farm ditches. Almost all farmers at all locations expressed satisfaction (Table 34). Since the ditches "belong" to the farmers and they are responsible for cleaning them, it is not surprising that farmers express satisfaction towards their own work.

Table 34. Sample farmer satisfaction with ditch maintenance in the wet season (by location).

Degree of Satisfaction (%)	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail
	number of responses*					
100	8(100)	6(100)	4(100)	4(80)	6(86)	4(67)
75						
50						1(17)
25						
0				1(20)	1(14)	1(17)
Not applicable	2	2	5	3	2	2

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

In the dry season, fewer farmers cultivate crops, and the crops grown do not require constant irrigation. Ditch maintenance, therefore, becomes less important. Almost all farmers interviewed said that they "never" clean ditches during the dry season.

Nevertheless, before receiving dry season irrigation water, some TOG leaders asked their TOG members to clean the main and farm ditches. Only farmers who irrigated in the dry season contributed to the effort. Exemptions were given to some farmers who were busy on the day set for farm ditch maintenance. Other TOG members did not participate in dry season maintenance because they claimed that they received their water from some other farmer's field rather than a ditch. Still others said they did not participate because they use only a very small quantity of water or because the flow of water in the farm ditch was sufficient without cleaning.

3. Conclusions

Data presented indicate that where farmers can see a benefit to themselves for participating in maintenance, they will participate. When they see no or little benefit, they will not participate. The problem is to create a local organization around a viable water share distribution system, such that all water users will have incentive to participate (see Volume 1).

Leadership appears to play an important role in maintenance. The WUA president does not take as active a role in maintenance as he does in water allocation, but he appears to be a prime motivator and organizer of farmers during emergency maintenance. The TOG leaders provide the real impetus for effective ditch maintenance.

C. CONFLICT MANAGEMENT

Whenever there are scarce natural resources, there is likely to be conflict over the use of such resources. Water at Lam Chamuak is no exception. Water conflicts at Lam Chamuak are usually seasonal. Since more farmers rely on irrigation in the wet season, water-related conflicts tend to increase in number, duration, and intensity.

Key informants were asked about the prevalence of water conflict. Since Thai culture stresses courtesy and politeness, farmers and officials invariably replied that there were no conflicts at Lam Chamuak. Researchers knew, however, that some conflicts were present, and probed to ascertain the most prevalent water "problems" informants had heard about.

Strictly speaking, some of the most frequent "problems" cited by farmer informants (such as cattle in the canals, vegetables growing on canal banks, and farmers breaking concrete on canal banks) may not be classified as "conflicts"; i.e., a competitive or antagonistic state of affairs. Other problems cited, however, do appear to be conflicts (Table 35). According to the farmer informants, water distribution "problems" between head and tail farmers on the main canals and farm ditches were relatively common, as were conflicts between farmers who grew different crops.

The responses from the key RID informants were similar. The same general pattern emerged: the major problems (or conflicts) were between head and tail farmers on the main canals and farm ditches.

The research assistant's observations along the RMC confirmed the key informants' responses. He reported that the two most prevalent forms of conflict were between head TOGs and tail TOGs along the main canal, and conflicts within a TOG. These conflicts were particularly prevalent during paddy transplanting, when water demand was high. Most Lam Chamuak water conflicts can be categorized as main system and turnout or farm level conflicts.

1. Main System Conflicts

Upstream disruption of water supply was a primary cause of conflict. Farmers along head ditches sometimes put check structures across the main canal to raise the water level to capture a greater volume of water. Tail farmers along the main canal were then deprived of water. This practice was particularly prevalent during paddy transplanting. Coincidentally, it was primarily the Thai Esan at the head of the system who were checking the main canal, depriving the Thai Korat of water.

Most sample farmers also reported that problems between head and tail farmers on the main canal are prevalent (Table 36). There was also a trend (Table 36) for the proportion of farmers reporting such problems to increase from head to tail, particularly along the more badly damaged LMC.

During the wet season, the research assistant often observed temporary checks in the main canals placed by farmers. For example, he saw check structures at turnout 8 on the LMC and turnout 9 on the RMC. This checking caused anger among farmers at turnout 14 on the LMC and turnout 22 on the RMC. This conflict was temporarily resolved when the

Table 35. Farmer and RID informant reports of most prevalent water "problems."

Problems	Number of Responses*
Reported by Key Farmer Informants	
Cattle walking by or resting in main canal	30 (17)**
Vegetable gardening along canal embankment	30 (17)
Farmers checking main canal to detriment of others	27 (15)
Water distribution between head and tail locations on main canal	27 (15)
Farmers break concrete canal banks	18 (10)
Water distribution between head and tail locations on ditch	16 (9)
Different crops with different water requirements (paddy versus cassava)	14 (8)
Farmers from outside command area siphon/pump water out of Lam Chamuak canal	13 (7)
Farmers disagreements with RID officials	4 (2)
Reported by Key RID Informants	
Water distribution problems between head and tail locations on main canal	16 (30)
Water distribution problems between head and tail locations on ditch	13 (25)
Farmers not allowing water to pass through their land to another's field	10 (19)
Different crops with different water requirements (paddy versus cassava)	7 (13)
Influential farmers using their power unfairly in irrigation matters	5 (9)
Thai Esan disagreements with Thai Korat	2 (4)

*Multiple responses allowed.
**() = Percent.

Table 36. Presence of problems between head and tail farmers on the main canal as reported by sample farmers (by location).

Do Problems	LMC			RMC		
Exist?	Head	Middle	Tail	Head	Middle	Tail
	number of responses*					
Yes	6(60)	5(63)	9(100)	6(75)	9(82)	7(88)
No	4(40)	3(38)		2(25)	2(18)	1(13)

*() = Percent of total responses from sample farmers at that location.

tail farmers removed the checks from the main canal without overt opposition.

If two disagreeing farmers lived in the same village, but had fields at different locations, often the WUA president mediated the dispute. The WUA president appeared to use his prestige and influence, not power, to informally mediate such disputes. If disputing farmers were from different villages, however, the WUA president usually did not become involved in the conflict. Some farmers reported that water disputes were usually addressed by the conflicting parties themselves, with no intervening third party. Sometimes, conflicts were left without resolution.

Local RID officials sometimes became involved in long-standing conflicts. Higher RID officials, however, asked local officials to encourage the farmers to solve problems on their own. These higher officials stressed that solutions should be devised to make water delivery to all users possible. Conflict would not be solved by taking a majority vote because the losers would no longer cooperate or participate in other group activities. If necessary, higher officials suggested, local RID officials should consult with other local government officers to manage conflict.

Sample farmers were asked if, in the past two or three years, they had heard of any problems between farmers and RID officials. Only 5 of 117 (4 percent) sample farmers stated that they had heard of such problems. The Thai researchers, however, observed signs of conflict and thought that the responses of the sample farmers reflected traditional Thai courtesy. When the research assistant approached the farmers in a more informal manner and gave them longer to respond to such questions, many farmers expressed dissatisfaction with the work of RID's canal caretakers. Expressed dissatisfaction became even stronger when farmers discussed removing sediment and weeds from main canals.

The farmers said that they did not mind helping the canal caretakers because they realized there were so few RID personnel at Lam Chamuak. However, they stated that the canal caretakers were not serious about their jobs. Farmers felt that the RID canal caretakers should not automatically rely upon the farmers for assistance and should rely more on themselves. The farmers knew that main canal maintenance was officially the responsibility of RID, not the farmers.

The canal caretakers, a tank caretaker, and the district O&M manager were aware of the farmer complaints. These local RID officials said that the farmers "offended" the canal caretakers because of misunderstandings and some questionable practices by a previous canal caretaker. They stated that the lack of personnel was one reason why they were not able to finish cleaning the canals, particularly during the wet season when weeds grow faster and sediment is heavy. Sometimes the task was simply beyond caretaker capabilities.

Sample farmers were asked to rate their satisfaction with the RID officials and their work (Table 37). Most farmers at all locations expressed a high degree of satisfaction, although the responses show a slight tendency for the tail farmers to be more dissatisfied than the head farmers.

Table 37. Sample farmers' satisfaction with RID officials and their work (by location).

Degree of Satisfaction (%)	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail
	number of responses*					
100	7(70)	6(75)	5(63)	5(63)	9(82)	5(63)
75	3(30)	2(25)	1(13)	2(25)	1(9)	1(13)
50						1(13)
25			1(13)		1(9)	1(13)
0			1(13)	1(13)		
Not applicable			1			

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

Most sample farmers thought that some conflicts result from non-cooperation among farmers in irrigation activities (Table 38). In addition, most sample farmers were satisfied with the cooperation displayed among WUA members (Table 39). Though sample farmers apparently believed that non-cooperation existed, they were satisfied with cooperation under the umbrella of the WUA. The data also revealed, however, that farmers at the tail of the system were more likely to express dissatisfaction with cooperation in the WUA than respondents at the head, particularly along the LMC.

Table 38. Non-cooperation among farmers in irrigation activities (by location).

Does Problem Exist?	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail
	number of responses*					
Yes	10(100)	6(75)	7(78)	6(75)	9(82)	7(88)
Never		2(25)	2(22)	2(25)	2(18)	1(12)

*() = Percent of total responses from sample farmers at that location.

Table 39. Sample farmer satisfaction with the cooperation of the WUA (by location).

Degree of Satisfaction (%)	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail
	number of responses*					
100	5(50)	2(25)	2(25)	4(50)	5(45)	5(63)
75	5(50)	5(63)	1(12)	4(50)	6(55)	2(25)
50						
25		1(13)	1(12)			1(12)
0			4(50)			
Not applicable			1			

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

2. TOG and Farm Level Conflict

Sample farmers were asked if there were problems between head and tail farmers within TOGs along ditches. Most sample farmers said that such problems do exist (Table 40).

Table 40. Presence of problems between head and tail farmers on farm ditch as reported by sample farmers (by location).

Do Problems Exist?	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail
	number of responses*					
Yes	6(60)	3(38)	6(67)	5(63)	8(73)	4(50)
No	4(40)	5(63)	3(33)	3(38)	3(27)	4(50)

*() = Percent of total responses from sample farmers at that location.

The research assistant reported that the most prevalent cause of conflict along main and farm ditches was disruption of water supplies. At some locations, the lack of farm ditches meant that farmers resorted to field-to-field flow. Intervening irrigators objected to other farmers' water passing through their fields. Decreasing water supply in the main canal also forced farmers at the head of the ditches to hoard water and overirrigate. At other locations, farmers tried to grow paddy on highland areas where it was difficult to get water.

There were also local conflicts between paddy farmers and cassava farmers. When paddy and cassava seasons overlapped, the cassava farmers did not like to let water pass through their fields to paddy fields because too much water could damage the cassava crop.

Sample farmers were asked about the prevalence of conflict between cassava and paddy farmers (Table 41). It appears that this conflict became more prevalent from head to tail. The Thai Esan farming at the head of the system grow more sesame, so they had few problems with cassava farmers. Farmers at the tail, who experienced more chronic water shortages and were more likely to grow cassava, were thus more likely to come into conflict with paddy farmers.

Table 41. Presence of problems between farmers growing paddy and farmers growing cassava as reported by sample farmers (by location).

Do Problems Exist?	LMC			RMC		
	Head	Middle	Tail	Head	Middle	Tail
	number of responses*					
Yes	1(10)	3(38)	6(67)	1(14)	5(45)	4(50)
No	9(90)	5(63)	3(33)	7(88)	6(55)	4(50)

*() = Percent of total responses from sample farmers at that location.

To prevent unwanted water from passing through their land, cassava farmers often placed cassava stalks in the farm ditch or at the farm turnout. When paddy farmers grew desperate for water they removed the cassava stalks from the ditch without permission of the cassava farmer and thereby generated conflict.

A similar water conflict was recorded between farmers who grew different varieties of paddy requiring different periods of growth and different amounts of water at differing times. The research assistant reported that in one instance, one farmer was diverting water for his paddy which was at the flowering stage, while another farmer on the same ditch wanted to harvest his paddy. This conflict was managed when the farmer harvesting paddy contacted the WUA president and succeeded in getting the president to stop water deliveries for the time required to harvest.

3. Dry Season Conflict

Conflict between head and tail farmers is less frequent in the dry season because the Thai Esan farmers at the head usually grow sesame, which requires little water. They only need to irrigate once, for land preparation. In general, the Thai Korat tail farmers do not crop in the dry season except for some limited vegetable gardening and cassava production. Nevertheless, some dry season conflicts do occur.

In the 1986 dry season, the agricultural extension worker persuaded farmers at the head of the RMC to grow about 40 rai (6.4 ha) of dry season irrigated crops as part of a demonstration program. In March 1986, the farmers working with the demonstration plots requested and received water from RID once a week. The farmers growing sesame did not want water. Occasionally, farmers working their demonstration fields applied water carelessly, and excess water ran into neighboring sesame fields. This angered the sesame farmers because the excess water threatened their crop and they felt that the demonstration farmers were wasting water that would be better left in the tank for the paddy growing season. Several farmers growing sesame asked RID not to deliver water to the demonstration farms too often. The WUA president mentioned that next year Lam Chamuak probably would not host the demonstration effort.

Other water conflicts occurred among the farmers working the demonstration farms. Some of the farmers working in this pilot project did not take their own rules seriously. At the beginning of this small pilot project, the demonstration farmers had agreed to take water by turns. Some farmers, however, took water out of turn. The demonstration farmers resolved this internal dispute themselves. They held a meeting where farmers emphasized the enforcement of water use rules, the rotation of water, and the proper distribution of information about water delivery. After this meeting, internal problems were minimized.

4. Conclusions

Despite the existence of conflicts at Lam Chamuak, especially during the wet season, there were no data to indicate that the conflicts ever became violent. This may be due partly to the rural Thai culture, where no one wishes to openly behave in a hostile manner towards another farmer with whom one must live for a lifetime.

The structural dimensions of the conflicts, however, go beyond the Thai culture. The most prevalent causes of conflict -- disruption of water supplies -- can adversely affect system performance. Though conflicts appeared to be fairly widespread, particularly between tail and head farmers along the main canal, conflicts are controlled.

D. LAM CHAMUAK WATER USERS' ASSOCIATION

How is the Lam Chamuak water users' association related to the management and structure of the irrigation system? The vice-presidential position has fallen into disuse since the occupant of that position is currently working in the Middle East. As has been evident in the analysis of water allocation, maintenance, and conflict management, the WUA president has tried to perform a variety of functions on both the LMC and RMC. The tasks, however, are too many and too complex for one person.

Farmer informants were asked if there were any problems in the existing WUA. Over half the key informants felt that there were problems (Table 42). Predominant responses were that the WUA was too large and lacked coordination in implementation. These two responses indicate perceived problems with the structure (size) and operations (implementation) of the association.

Table 42. Key informant reports of WUA problems.

	Number of Responses*
Problems Present?	
Yes	20(59)
No	14(41)
If yes, what were the problems?	
WUA is too large.	6(30)
Lacks coordination in implementation.	4(20)
Lack of unity.	2(10)
Selfish farmers.	2(10)
Unreliable water delivery.	2(10)
Some people try to sabotage WUA.	1(5)
Those not getting benefits are not interested in WUA.	1(5)
Land is inaccessible to water.	1(5)
WUA members do not understand rules.	1(5)

*() = Percent of total responses.

Key RID informants were also asked if there were problems with the present WUA. They had three general responses:

1. The WUA was too large to communicate with all members, to admin ter, and to hold a meeting where all members know each other.

2. WUA objectiv s were too broad.

3. The WUA struc ure was inappropriate; a small group of people cannot manage it properly.

The research assistant talked informally with Lam Chamuak farmers who mentioned inefficiency, the inability of the WUA president to correctly manage the water, the inability of the WUA to provide equipment like pumps to help farmers, water theft among users, and water conflict.

These organizational problems were seen to affect farmers' irrigation behavior. During the 1986 dry season, many farmers obeyed the TOG rules along the farm ditches. However, these same farmers predicted that in the 1986 wet season, when water would be much more critical to many farmers, rules would not be followed.

Though the WUA has certainly experienced problems, it has proved beneficial to some members. The benefits, however, have been different in different locations. Sample farmers were asked which WUA activity benefited them (Table 43). Almost all head farmers and many middle farmers believed that WUA water allocation activities have benefited them. Most tail farmers, however, particularly along the LMC, responded that they have received no benefit from the WUA.

Table 43. Sample farmer reports of WUA activity benefiting them (by location).

WUA Activity	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail
	---------------number of responses*-----------					
Water allocation	7(70)	5(63)		7(88)	4(36)	4(50)
Contact RID official Through WUA officials	1(10)				1(9)	
Provide information			2(22)			
Water allocation and provide information	1(10)			1(12)		
No benefit	1(10)	3(38)	7(78)		6(55)	4(50)

*() = Percent of total responses from sample farmers at that location.

Some of these responses could be attributed to the WUA president, who is the most active individual in the WUA and who resides at the head of the system where most of his work can pay dividends. Tail farmers are frustrated at the WUA's inability to improve irrigation conditions for them.

The structure and operation of the Lam Chamuak WUA, therefore, contributes to poor irrigation system performance. Farmers feel the organization is too large and unwieldy to benefit them greatly. This inappropriate structure leads to a lack of mutually agreed upon rules and enforcement of these rules varies, but is generally lax. As the next section of this research report demonstrates, the breakdown of the social organization of irrigation directly harms the farmers' water control throughout the system, and degraded water control is directly connected to reduced yields.

VI. WATER CONTROL

This chapter examines water control based on observation of the physical state of the system, farmers' perceived problems, farmers' irrigation behavior, and the adequacy, reliability, and equity of water delivery. In particular, this chapter examines the following issues: Are farmers able to receive enough water at the right place and at the right time to meet crop water requirements? Do farmers receive water based on the amount of effort they put into the system, or are some farmers advantaged by location alone in that they receive water regardless of their willingness to support organized, collective effort to manage water effectively?

A. PHYSICAL CONDITION OF THE SYSTEM

The condition of the canals, structures, and land affect the potential water control within any irrigation system. Physical problems at Lam Chamuak contribute greatly to creating differing amounts of water control.

The field research engineer working at Lam Chamuak reported that the LMC has a very steep slope. Farmers along the LMC reported that the water flows so fast they cannot divert it. The field research engineer also reported that along the middle of the RMC (km 4.0 to km 6.5), the canal profile is too low to adequately command fields. Additionally, whenever the water flow increased significantly in the low portion of the RMC, the canal broke with significant water losses.

Concrete linings were seriously damaged, particularly along the LMC. This condition adversely affects the efficiency of water delivery. In the unlined portion of the LMC (km 5.4 to km 7.4) there were high conveyance losses due to seepage and leakage. Dense weeds grow in both the RMC and LMC, further reducing efficiency.

Sample farmers were asked to rate their satisfaction with the construction of the main canal (Table 44). Head and middle farmers along both main canals were more likely to be satisfied with the construction than tail farmers. When comparing LMC responses to RMC responses, a significant number of RMC farmers rated their satisfaction at 100 percent. No LMC farmer rated his satisfaction at 100 percent. Conversely, half of the LMC farmers rated their satisfaction at 0 or 25 percent. Far fewer farmers on RMC rated their satisfaction this low.

Sedimentation in the main canals is another major obstacle to efficient water delivery. As there are no adequate cross drains or drainage structures at Lam Chamuak, runoff during heavy rains carries sediments downslope to the main canals. There are few bridges for cattle crossings, and animals damage the canal banks when crossing, contributing to sedimentation. Finally, many farmers, particularly along the RMC, irrigate vegetables along the canal banks. Runoff from vegetable irrigation further contributes to canal sedimentation.

Table 44. Sample farmer satisfaction with main canal construction (by location).

Degree of Satisfaction (%)	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail
	number of responses*					
100				4(50)	5(45)	2(25)
75	4(40)	6(75)	1(13)	3(38)	3(27)	2(25)
50		1(13)			1(9)	
25	3(30)	1(13)			2(18)	3(38)
0	3(30)		7(87)	1(13)		1(13)
Not Applicable			1			

*() = Percent of total responses from sample farmers, excluding "not applicable" responses.

Some farmers stated that many of the 54 authorized turnouts on the two main canals were located too high or too low. Where the turnouts are too high on the canal banks, farmers or RID officials place checks in the canal to raise the water level to the turnout. Where the turnout is too low, it is likely that the farm ditch is lower than the farmers' fields, making it necessary to raise the water to the fields.

Sample farmers were asked to rate their satisfaction with the location of their turnouts (Table 45). Most farmers at all locations expressed high satisfaction with their turnout location, although approximately 25 percent of the farmers along both the LMC and RMC expressed no satisfaction with their turnout location.

Table 45. Degree of sample farmer satisfaction with location of turnout (by location).

Degree of Satisfaction (%)	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail
	number of responses*					
100	5(50)	6(75)	3(38)	5(63)	7(64)	3(38)
75	3(30)	2(25)	2(25)	1(13)	2(18)	2(25)
50					1(9)	
25					1(9)	
0	2(20)		3(38)	2(25)		3(38)
Not Applicable			1			

*() = Percent of total responses from sample farmers, excluding "not applicable" responses.

Much of the land throughout the system is lowland subject to drainage problems. Drainage water from paddy irrigation collects in low-lying areas and results in poor soil quality. Farmers at the middle and tail of the LMC (turnouts 17, 20, 25, and 27) and RMC (turnouts 17, 22, and 24) said that they were sometimes plagued with waterlogging. Some of this excessive water drains into the Lam Chamuak stream and is re-used by farmers downstream.

Excessively low turnouts also contribute to waterlogging. Water from the low turnouts and low farm ditches cannot reach the fields and becomes waste water, collecting in low-lying areas. To prevent this from happening, farmers at one turnout at the tail of the RMC used concrete to reduce the turnout size and thus, the amount of water flowing into the farm ditch.

B. PERCEIVED PROBLEMS

1. In the Main System

Sample farmers and key informants were asked what they felt was their most important problem in increasing crop production. According to sample farmers, the three most prevalent problems given were lack of water, salinity, and infertile land (Table 46). Lack of water is the most prevalent problem perceived at the extreme tail and at the tail of the LMC. Most farmers at the RMC, however, including tail farmers, claim that salinity is their most important problem.

Table 46. Most important problem constraining increased crop production as reported by sample farmers (by location).

Most Important Problem	LMC			RMC			Extreme Tail
	Head	Middle	Tail	head	Middle	Tail	
	number of responses*						
Lack of water	2(20)	1(13)	3(33)		2(18)	1(13)	25(40)
Salinity		1(13)	3(33)	4(50)	6(55)	4(50)	8(13)
Infertile land	2(20)			1(13)	1(9)		7(11)
Unlevelled land	1(10)	4(50)	2(22)			1(13)	2(3)
Plant disease	2(20)			2(25)			6(10)
Lack of fertilizer	3(30)		1(11)		1(9)	1(13)	3(5)
Too much water		1(13)			1(9)	1(13)	
Marketing							2(3)
Other soil problems		1(13)					1(2)
Other problems				1(13)			9(14)

*() = Percent of total responses from sample farmers at that location.

The importance of the salinity problem was confirmed by research observations which noted a number of saline fields at the tail and extreme tail of the system. In the middle of the system, particularly on the LMC, there are low-lying areas and waterlogging. This information corresponds to the pattern of response found in Table 46.

In a more informal and unstructured setting, key farmer and RID informants were asked about constraints to increasing crop production.

Their responses (Tables 47 and 48) also indicated that water and soil problems were the most important constraints. In Table 47, farmer informants named water as their most important problem, followed by soil quality, and lack of agricultural innovations. RID informants mentioned the same problems, although water and soil quality were given equal importance. The soil quality problem is related to the salinity problem that sample farmers stressed.

Table 47. Farmor informant opinions of major constraints to increasing crop production.

Constraint	Order of Importance		
	1*	2	3
	number of responses**		
Water	20(59)	3(11)	5(29)
Soil quality	8(24)	7(25)	4(24)
Lack of agricultural innovation	5(15)	10(36)	3(18)
Farm size		5(18)	1(6)
Lack of markets			4(24)
Credit		3(11)	
Land levelness (highland/lowland)	1(3)		

*Most important.
**() = Percent of responses from farmer informants.

Table 48. RID informant opinions of major constraints to increasing crop yields.

Constraint	Number of Responses*
Inadequate water	14(30)**
Poor soil quality	14(30)
Lack of agricultural innovation	9(20)
Lack of markets	2(4)
Small farm size	2(4)
Others	5(11)

*Multiple responses allowed.
**() = Relative percent.

Considering that most key informants listed water as a primary constraint to increasing crop production, they were asked what aspect of water was a major problem (Tables 49 and 50). The largest number of key informants reported that the lack of regulation governing water use and the lack of farmer knowledge about water application were the major problems.

Table 49. Farmer informants' views of important water problems.

Water Problem	Order of Importance		
	1	2	3
	---- number of responses*------		
Farmers lack rules and regulations over water use and maintenance	11(35)	7(24)	3(14)
Farmers lack water application knowledge	6(19)	7(24)	2(10)
Sediment in canal	4(13)	2(7)	
Land levelness (highland/lowland)	3(10)	2(7)	3(14)
Land inaccessible to water	3(10)		
Unreliable water deliveries	2(6)	1(3)	2(10)
Inequitable water delivery (head/tail)		6(21)	2(10)
Water supply does not meet demand	1(3)	2(7)	2(10)
Every farmer does not receive water	1(3)	1(3)	4(19)
Unlined canal		1(3)	2(10)
Soil does not hold water			1(5)

*() = Percent of responses from key farmer informants.

Table 50. RID informants' views of important water problems.

Water Problem	Number of Responses*
Farmers lack regulations for allocation and maintenance	14(31)**
Farmers lack appropriate knowledge of water application	12(27)
Inequitable water delivery between head and tail	6(13)
Not every farmer gets water	4(9)
Duration of water delivery is too short	4(9)
Small water supply	3(7)
Unreliable water delivery	2(4)

*Multiple responses allowed.
**() = Relative percent.

Data in Tables 49 and 50 indicate that key informants believed that organizational problems (lack of effective rules, knowledge, and water reliability, and head-tail problems in water delivery) were of paramount importance. Since many of the key farmer informants are TOG leaders who must deal with organizational issues every day, it was not surprising to find that they were concerned about organizational issues.

Sample farmers and key informants were asked what they felt would be the most effective solutions to the crop production constraints they had listed. Although responses are scattered, two clusters of response indicate that most Lam Chamuak farmers want "nature" to solve their problems (i.e., let the problems solve themselves) or they do not know how to solve them (Table 51). Though many sample farmers were not satisfied with current solutions, the overall response of the sample farmers to other potential solutions seemed to be resignation.

Table 51. Sample farmer opinions on best solutions to crop production constraints (by location).

Solutions	LMC			RMC			Extreme
	Head	Middle	Tail	Head	Middle	Tail	Tail
	-----------------number of responses*-----------------						
Let nature solve		2(25)	2(22)		2(20)	2(25)	27(48)
Use fertilizer	2(20)			1(13)	1(10)		6(11)
Money	2(20)	1(13)				1(13)	4(7)
Need RID advisor and help	2(20)		1(11)	1(13)			
Use of pesticides							3(5)
Consult with other farmers	1(10)						1(2)
Other solutions	1(10)		1(11)	1(13)		1(13)	1(2)
Do not know	2(20)	5(63)	5(55)	5(63)	7(70)	4(50)	14(25)
Not applicable					1		7

*() = Percent of total responses from sample farmers excluding "not applicable" responses.

Key informants, however, had much stronger views regarding potential solutions. Farmer informants (Table 52) clearly seek organizational solutions to their problems, such as holding farmer meetings to establish rules and explain them. Purely physical solutions (land leveling, better water delivery) received less attention from these leaders.

Table 52. Farmer informants' proposed solutions to water problems.

Proposed Solutions	Number of Responses*
Establish rules	13(41)
Farmer meeting for explanation	7(22)
Land leveling	3(9)
Deliver water on demand	3(9)
Canal caretakers should pay more attention	2(6)
Clean the canals	2(6)
Request water from TOG leader	1(3)
Punish farmers who break rules	
Cannot be solved	1(3)

*() = Percent of total responses.

The questions and data described above were general. Sample farmers and key informants were also asked more specific questions. Sample farmers were asked if they experienced problems with the water delivery system. Table 53 indicates that head farmers on both main canals felt that they had few water delivery problems. However, the tail farmers stated that head farmers used all the water, leaving little for the tail.

Table 53 also indicates that farmers at the tail of the RMC perceive fewer water delivery problems than do farmers at the tail of the LMC. Two sample farmers at the tail of the RMC reported that they had no water delivery problems, while all the LMC tail farmers reported problems.

Table 53. Water delivery problems reported by sample farmers (by location).

Water Delivery Problems	LMC			RMC		
	Head	Middle	Tail	Head	Middle	Tail
	------------number of responses*--------------					
Head farmers use all the water		4(50)	7(100)		6(55)	5(63)
Conflict over water use	1(10)				2(18)	
Not enough water	1(10)					1(13)
Too much water					1(9)	
No problems	8(10)	4(50)		7(100)	2(18)	2(25)
Not applicable			2	1		

*() = Percent of total responses from sample farmers, excluding "not applicable" responses.

When asked about the major water control problems along the main canals, the farmer and RID informants identified similar problems (Table 54 and 55). They said that major problems are due to sediment in the canals, farmers checking water in the main canals, and water seepage due to canal damage or unlined portions. The numerous problems listed by key informants indicate the breadth of water control problems at Lam Chamuak.

Key informants were asked to suggest potential solutions to water control problems they listed. Their responses, displayed in Tables 56 and 57, indicate that the informants felt that organizational and physical solutions are necessary. The most prominent response by farmer informants was the need to establish regulations. The second most popular suggestion was to clean the canals.

Table 54. Farmer informants' perceived water control problems on the main canal.

Perceived Problems	Number of Responses*
Sediments	28(26)**
Checking the main canal	23(22)
Seepage due to canal drainage	21(20)
Seepage due to unlined canals	10(9)
Illegal outlets	9(8)
Incorrect turnout location	4(4)
No rules for water use	3(3)
Small water supply	2(2)
Land inaccessible to water	2(2)
Garbage thrown into canal	2(2)
Water flows too fast in canal	1(1)
Lack of RID/farmer coordination	1(1)
No problems	1(1)

*Multiple responses allowed.
**() = Relative percent.

Table 55. RID informants' perceived water control problems on the main canal.

Perceived Problem	Number of Responses*
Sediments	14(28)**
Farmers check on main canal	13(26)
Seepage due to unlined canal	8(16)
Illegal outlets	5(10)
Water loss due to damaged concrete	3(6)
Small water supply	3(6)
Others	4(8)

*Multiple responses allowed.
**() = Relative percent.

Table 56. Farmer informants' proposed solutions to water control problems on main canal.

Proposed Solutions	Number of Responses*
Establish regulations	12(32)**
Clean the canals	9(24)
Adjust the turnout position	3(8)
Farmer meeting for explanation	3(8)
Adjust the land level	3(8)
Punishment	2(5)
Others	6(16)

*Multiple responses allowed.
**() = Relative percent.

Table 57. RID informants' proposed solutions to water control problems on main canal.

Proposed Solutions	Number of Responses*
Improve physical structures	15(54)**
Establish regulations over water use	9(32)
Meet with farmers to explain how to apply irrigation water	4(14)

*Multiple responses allowed.
**() = Relative percent.

RID informants responded most often that improving physical structures would be a good solution. The second most popular RID response was establishing regulations for water use.

2. At the Farm Ditch Level

Sample farmers were asked how they deliver water to their farms. Most head and middle farmers on both canals said they received water directly from the farm ditch (Table 58). Many middle and tail farmers reported that water passes through other farms before they receive it. Such a water distribution system can be unreliable, since intervening farmers working upstream fields control access to the water.

Table 58. Methods of water delivery to farms as reported by sample farmers (by location).

Methods of Water Delivery	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail
	number of responses*					
Directly from farm ditch	6(60)	5(63)	2(29)	7(88)	6(55)	2(40)
Let water pass through other farms	3(30)	2(25)	3(43)		5(45)	1(20)
Some water directly from farm ditch; some water passes through other farms	1(10)	1(13)		1(12)		
Others			2(29)			2(40)
Not applicable			2			3

*() = Percent of total responses from sample farmers, excluding "not applicable" responses.

Tail farmers who reported "other" methods (Table 58) relied on pumping water from the Lam Chamuak stream or taking water from natural ponds -- solutions which provided more water control than canal operations as long as there was water in the stream and ponds.

When asked to identify the most important problems of delivering water to their farms, sample farmers reported that inaccessibility of land to water, waterlogging, and lack of canal water were the biggest problems (Table 59). However, over half of the head farmers on the LMC and RMC reported that they had no problem obtaining water. Additionally, a significant proportion of farmers along the middle of the RMC reported no problems, indicating that irrigation conditions along the RMC may be generally better than the LMC.

Table 59. Most important constraint to getting water to farms as reported by sample farmers (by location).

	LMC			RMC		
Problem	Head	Middle	Tail	Head	Middle	Tail
	------------number of responses*------------					
Land inaccessible	4(40)	5(63)	3(43)	2(25)	4(36)	3(38)
Waterlogging	1(10)	1(13)	2(29)		2(18)	2(25)
Lack of water		1(13)	2(29)			3(38)
No problem	5(50)	1(13)		6(75)	5(45)	
Not applicable			2			

*() = Percent of total responses from sample farmers, excluding "not applicable" responses.

Sample farmers were also asked to rate their satisfaction with the convenience of getting water to their farms (Table 60). Again, farmers at the head of the main canals expressed far greater satisfaction than farmers at the tail. Also, a greater number of RMC farmers at all locations expressed satisfaction than did LMC farmers.

Table 60. Sample farmers' degree of satisfaction with convenience of getting water to farm land (by location).

Degree of	LMC			RMC		
Satisfaction (%)	Head	Middle	Tail	Head	Middle	Tail
	------------number of responses*------------					
100	4(44)	4(50)		7(88)	6(60)	3(38)
75	3(33)	2(25)		1(12)	2(20)	
50	1(11)	1(13)				
25	1(11)		1(14)			2(25)
0		1(13)	6(86)		2(20)	3(38)
Not Applicable	1		2		1	

*() = Percent of total responses from sample farmers, excluding "not applicable" responses.

Key informants were asked more specific questions about water control problems at the farm ditch level (Table 61). Farmer and RID informant responses were similar. The most prevalent water control problems identified on the farm ditch were farmers checking the farm ditch to the disadvantage of others and failure to clean out weeds. Other problems mentioned were the lack of regulations, and seepage.

Table 61. Farmer and RID informants' perceived water control problems along farm ditches.

Perceived Problems	Number of Responses*
Farmer Key Informants	
Checking in the farm ditch	19(36)**
Farm ditch filled with weeds	7(13)
No regulations for water use	4(8)
Seepage from unlined farm ditch	3(6)
Small water supply	3(6)
Inequity of water use between head and tail farmers	3(6)
Sediments in farm ditch	2(4)
Land inaccessible to water	1(2)
No problem	11(21)
RID Key Informants	
Farmers checking farm ditch	11(31)
Weeds in farm ditch	7(20)
Seepage from unlined ditch	7(20)
Small water supply	5(14)
Lack regulations for water use	5(14)

*Multiple responses allowed.
**() = Relative percent.

Table 62 summarizes the key informants' ideas about how farm ditch water control problems could be solved. The most prevalent response for both farmer and RID key informants was to establish new regulations or enforce existing ones. Farmer informants also favored holding a farmer meeting to explain regulations. RID informants favored instituting a rotational water delivery system along the farm ditches.

C. FARMERS' IRRIGATION BEHAVIOR

Variations in water control relate to differences in irrigation behavior. To gain a greater degree of water control, farmers at Lam Chamuak have physically and operationally altered the system. Unauthorized turnouts have been constructed, particularly along the RMC. Several unauthorized turnouts along the RMC are listed in Appendix F.

Some RMC farmers had an explanation for the unauthorized outlets. When RID constructed the irrigation system in the 1960s, some farmers did not approve of the proposed turnout locations. Some farmers went to the building contractor and asked him to change the turnout locations. If the contractor agreed to the farmers' suggestions, these farmers reportedly rewarded him with a chicken or liquor. Informants stated that these farmers received the best turnout locations. The

Table 62. Farmer and RID informants' proposed solutions to water control problems along the farm ditch.

Proposed Solutions	Number of Responses*
Farmer Key Informants	
Establish regulations	6(32)
Farmer meeting for explanation	4(21)
Good maintenance	2(11)
Improve water delivery system	2(11)
Punishment	2(11)
Warnings given	1(5)
Checking to ensure farmers obey	1(5)
Line the farm ditches with concrete	1(5)
RID Key Informants	
Have TOGs enforce regulations	7(44)
Rotational deliveries of water	5(31)
Explain water application to farmers	4(25)

*() = Percent of key informants' responses.

implication was that it was LMC farmers who received better turnout locations, forcing RMC farmers to "improve" their turnout locations on their own.

There are agricultural reasons why the LMC farmers would initially be more interested in correct turnout locations. When the irrigation system was built, LMC farmers grew more paddy, sesame, and vegetables. RMC farmers grew more cassava and vegetables. During this time, the RMC farmers weren't that concerned about irrigation water because their crops did not require the water control demanded by paddy. Additionally, there are more highlands along the RMC, meaning that irrigation was not an obvious option.

In addition to unauthorized turnouts, farmers have altered the operation of the system in other ways to increase their water control. Most strategic in this regard was placing checks in the main canals to raise the canal water levels. If checking is not coordinated with other TOGs, downstream farmers must contend with inadequate and unreliable water supplies.

To examine further how physical and social organizational constraints affect farmer irrigation behavior, sample farmers were asked what criteria they use to decide when to irrigate paddy. Most farmers indicated that they irrigated according to soil conditions or whenever water was available (Table 63).

The response "whenever water is available" indicates a lack of water control. More LMC than RMC farmers reported that they begin irrigating whenever they can get water. What is surprising is the number of responses at the tails of both canals indicating that tail farmers irrigate according to soil or crop conditions. This indicates the presence of alternative water sources (e.g., natural ponds) served by return flows at the tail of the system.

Table 63. Criteria sample farmers used for irrigating paddy (by location).

Criteria	LMC			RMC		
	Head	Middle	Tail	Head	Middle	Tail
	---------------number of responses*-----------					
Soil condition	5(50)	5(63)	2(33)	3(38)	5(45)	4(57)
Whenever water is available from tank	3(30)	2(25)	3(50)	2(25)	4(36)	1(14)
Crop growth	1(10)	1(13)	1(17)			
Soil condition and crop growth				2(25)	2(18)	2(29)
Time schedule	1(10)			1(13)		
Not applicable			3			1

*() = Percent of total responses from sample farmers, excluding "not applicable" responses.

D. SYSTEM PERFORMANCE

Two variables which measure system performance are the time required for water to reach a farmer's field and the duration of water delivery. Sample farmers were asked how long it takes water to reach their fields after water is first released from the tank. Most head farmers reported that it takes one day or less to receive water (Table 64). Most tail farmers, particularly along the LMC, reported that it takes two or more days to receive water. Almost one-third of the sample farmers -- all from the middle and tail of the canals -- reported that they cannot estimate the time it takes because they only know when water will arrive when they see it in the canal. This uncertainty is a clear sign of poor water control.

Information gathered from case study farmers supports the pattern reported in Table 64. A case study farmer at the LMC head reported that it takes one day for water to reach his fields after water is released from the tank. The LMC middle case study farmer claimed that it took three days for water to reach him, and the LMC tail farmer estimated that he receives water only after five to seven days. The RMC middle case study farmer reported that he receives water in two days, and the RMC tail case study farmer stated that it takes three to seven days for water to reach his fields.

Table 64. Time required for water to reach fields after first day of release from the tank, according to sample farmers (by location).

Number of Days	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail
	number of responses*					
Less than one day	3(33)			3(38)		
One day	4(44)	4(50)		4(50)	4(36)	2(25)
Two days		1(13)	1(14)		1(9)	
Three days	1(11)		1(14)			2(25)
More than three days	1(11)	1(13)			1(9)	
Only know when see water in canal		2(25)	5(71)	1(13)	5(45)	4(50)
Not applicable	1		2			

*() = Percent of total responses from sample farmers, excluding "not applicable" responses.

Sample farmers were asked to rate their satisfaction with the duration of water deliveries to their farms (Table 65). Head farmers were far more satisfied with the duration than tail farmers.

Table 65. Degree of sample farmer satisfaction with duration of water delivery (by location).

Degree of Satisfaction (%)	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail
	number of responses*					
100	7(70)	4(50)		7(88)	4(36)	4(50)
75	2(20)	2(25)			2(18)	
50					1(9)	
25	1(10)			1(12)		
0		2(25)	7(100)		4(36)	4(50)
Not applicable			2			

*() = Percent of total responses from sample farmers, excluding "not applicable" responses.

E. WATER ADEQUACY, RELIABILITY, AND EQUITY

All 117 sample farmers plus key informants were asked to rate the adequacy, reliability, and equity of water deliveries for four critical stages of paddy cultivation: land preparation, transplanting, early growth, and flowering. The sample farmers' responses regarding the adequacy of water deliveries are displayed in Table 66. In general, head farmers on the LMC and RMC farmers rate water adequacy significantly higher than other farmers.

At all four stages of paddy cultivation, all head farmers and most middle farmers said that they "always" receive adequate water. Most tail farmers responded "sometimes" or "never." A few RMC tail farmers said that they always receive adequate water.

Table 66. Adequacy of water delivery for paddy according to sample farmers (by location).

Water Adequacy	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail	Extreme Tail
	-----	-----	-----	number of responses*	-----	-----	-----
For land preparation							
Always	10(100)	6(86)	2(25)	8(100)	8(73)	4(57)	8(19)
Often							4(9)
Sometimes			3(38)		1(9)		5(12)
Seldom		1(14)	1(13)		2(18)	2(29)	16(37)
Never			2(25)			1(14)	10(23)
Not applicable		1	1			1	20
For transplanting							
Always	10(100)	6(86)	3(38)	8(100)	8(89)	3(93)	7(16)
Often					1(11)	1(14)	3(7)
Sometimes			2(25)				7(16)
Seldom		1(14)	1(13)			2(29)	16(37)
Never			2(25)			1(14)	10(23)
Not applicable		1	1		2	1	20
For early growth							
Always	10(100)	7(88)		7(100)	7(70)	2(33)	6(14)
Often		1(12)	2(25)		1(10)	1(17)	4(9)
Sometimes			2(25)		1(10)	1(17)	7(16)
Seldom			2(25)		1(10)	1(17)	19(44)
Never			2(25)			1(17)	7(16)
Not applicable			1	1	1	2	20
For flowering							
Always	10(100)	7(88)		7(100)	7(64)	2(33)	6(14)
Often		1(12)	1(13)		1(9)	1(17)	1(2)
Sometimes			2(25)		1(9)	1(17)	8(19)
Seldom			3(38)		1(9)	1(17)	18(42)
Never			2(25)		1(9)	1(17)	10(23)
Not applicable			1	1		2	20

*() = Percent of total responses from sample farmers, excluding "not applicable" responses.

At all four stages, most farmers at the extreme tail said they "seldom" receive adequate water. A few farmers at the extreme tail, however, said that they "always" receive adequate water. These few farmers have access to alternate sources of water, such as natural ponds or water from the Lam Chamuak stream, since it has been established that they are not served by the main canals.

Farmer informants were also asked to rate the adequacy of water along the main canals and the farm ditches. Table 67 indicates that most key farmer informants rated water adequacy very high, from 75 to 100 percent adequate. These results differ somewhat from the sample farmers' responses (Table 66), where more responses were critical of water adequacy. This is understandable when one notes that TOG leaders are disproportionately represented among key farmer informants.

Table 67. Farmer informants' rating of adequacy of water along main canal and farm ditches.

Adequacy of Water	Number of Responses*
Along Main Canal (%)	
100	18(56)
75	3(9)
50	6(19)
25	4(13)
0	1(3)
Along Farm Ditch (%)	
100	18(64)
75	2(7)
50	6(21)
25	1(4)
0	1(4)

*() = Percent of informants' responses for that location.

Sample farmers were asked to rate reliability of water deliveries during the four stages of paddy cultivation (Table 68). All head farmers and most middle farmers said that water deliveries were "always" reliable. Tail farmers generally responded water deliveries were "never" or were "seldom" reliable. A few RMC tail farmers, however, responded that the water deliveries were "always" reliable. Farmers at the tail and extreme tail were more critical about water reliability than they were of water adequacy. The most prevalent response from tail and extreme tail farmers was that water deliveries were "never" reliable.

Sample farmers rated their satisfaction with water reliability (Table 69). Most head and middle farmers said that they were 100 percent or 75 percent satisfied. Most tail farmers stated that they were not at all or were only 25 percent satisfied with water reliability. Again, RMC farmers generally expressed a higher degree of satisfaction than LMC farmers.

Farmer informants were also asked to rate water reliability along the main canals and farm ditches (Table 70). The key informants, like the sample farmers, were more critical of water reliability than of water adequacy, particularly along the main canals. Half of the key informants along the main canal said that water was never reliable, although most said that water is often reliable along the farm ditches.

Table 68. Reliability of water deliveries for paddy according to sample farmers (by location).

Water Reliability	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail	Extreme Tail
	number of responses*						
For land preparation							
Always	10(100)	6(86)	1(13)	8(100)	8(73)	2(29)	4(9)
Often							1(2)
Sometimes			1(13)			1(14)	2(5)
Seldom		1(14)	1(13)		1(9)		11(26)
Never			5(63)		2(18)	4(57)	25(58)
Not applicable		1	1			1	20
For transplanting							
Always	10(100)	6(86)		8(100)	8(89)	3(43)	5(12)
Often			1(13)		1(11)		1(2)
Sometimes			1(13)			1(14)	4(9)
Seldom		1(14)	2(25)				11(26)
Never			4(50)			3(43)	22(51)
Not applicable		1	1		2	1	20
For early growth							
Always	10(100)	7(88)		7(100)	7(70)	2(33)	5(12)
Often		1(12)			1(10)		3(7)
Sometimes			3(38)		1(10)	1(17)	5(12)
Seldom			1(13)			1(17)	7(16)
Never			4(50)		1(10)	2(33)	23(53)
Not applicable			1	1	1	2	20
For flowering							
Always	10(100)	7(88)		7(100)	7(64)	2(33)	5(12)
Often		1(12)			1(9)		1(2)
Sometimes			2(25)		2(18)	1(17)	6(14)
Seldom			2(25)			1(17)	8(19)
Never			4(50)		1(9)	2(33)	23(53)
Not applicable			1	1		2	20

*() = Percent of total responses from sample farmers, excluding "not applicable" responses.

Water volumes are more adequate than they are reliable. Farmer informants were asked about the equity of water deliveries between head and tail farmers. Almost all informants stated that water is either "never" or is "seldom" equitably delivered on the main canals, and almost two-thirds of the key informants said that deliveries are "never" equitable along farm ditches (Table 71).

Table 69. Sample farmer satisfaction with water reliability (by location).

Degree of Satisfaction (%)	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail
	---------------number of responses*-----------					
100	7(70)	4(50)		7(88)	5(45)	4(50)
75	2(20)	2(25)			1(9)	
50					1(9)	
25				1(12)	1(9)	1(13)
0	1(10)	2(25)	6(100)		3(27)	3(38)
Not applicable			3			

*() = Percent of total responses from sample farmers, excluding "not applicable" responses.

Table 70. Farmer informants' ratings of water reliability along the main canal and farm ditches.

Water Reliability	Number of Responses*
Along Main Canal	
Often	15(47)
Seldom	1(3)
Never	16(50)
Along Farm Ditch	
Often	16(57)
Seldom	4(14)
Never	8(29)

*() = Percent of total responses from sample farmers, excluding "not applicable" responses.

Table 71. Farmer informant ratings of the equity of water deliveries between head and tail farmers along main canal and farm ditches.

Equity of Water Delivery	Number of Responses*
Along Main Canal	
Often	2(6)
Seldom	5(16)
Never	25(78)
Along Farm Ditch	
Often	9(33)
Seldom	2(7)
Never	16(59)

*() = Percent of informants' responses for that location.

Sample farmers were asked to rate their satisfaction with the equity of water deliveries (Table 72). Head and middle farmers generally felt that equity of water deliveries was satisfactory. Tail farmers were quite dissatisfied. RMC farmers expressed greater satisfaction than LMC farmers.

Table 72. Degree of sample farmer satisfaction with equity of water deliveries (by location).

Degree of Satisfaction (%)	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail
	number of responses*					
100	8(80)	5(63)	1(14)	8(100)	6(55)	4(50)
75	1(10)	2(25)	1(14)		2(18)	
50						
25	1(10)					
0		1(13)	5(71)		3(27)	4(50)
Not applicable			2			

*() = Percent of total responses from sample farmers, excluding "not applicable" responses.

F. CONCLUSION

Even though farmers generally felt that water was adequate at Lam Chamuak (perhaps due to the many alternate sources of water), they also felt that water deliveries were not reliable and were even less equitable. Lam Chamuak farmers use a variety of water sources for irrigation -- canal water, stream water, rain, pond water, and drainage water. Though not all farmers have access to all sources, some water source (e.g., rain) is available to all Lam Chamuak farmers.

Canal water is convenient and requires relatively little expense and effort. Other sources of water (pumping or diverting water from streams or ponds) require equipment and considerable labor, but the potential degree of water control is higher. Recall that farmers at the head of the system are more likely to use canal water than farmers at the tail, particularly in the wet season. Farmers at the tail are far more likely to rely on rain during the wet season.

Recall that although some Lam Chamuak farmers can rely on a number of different water sources, they must contend with farmers from outside the command area using Lam Chamuak water. While access to different water sources can improve a farmer's water control, that control could be diminished if unexpected interruptions occur.

Canal water is particularly affected by outside irrigators. Encroaching farmers at the tank use water in the dry season that could be used for diversified cropping below the tank. Farmers outside the command area at the tail of the LMC also use water that could be going to tail farmers within the command area.

Holding all other factors constant, the better the water control, the better agricultural performance should be. The next chapter examines the agricultural outcomes at Lam Chamuak.

VII. AGRICULTURAL OUTCOMES AT LAM CHAMUAK

The Lam Chamuak irrigation system was designed and constructed to supplement rainfall for wet season paddy production. In the past few years, however, the Royal Thai government has encouraged farmers to grow more dry season crops, such as vegetables and fruits. Some Lam Chamuak farmers do use irrigation water in the dry season, but many leave the area and work on nearby plantations or in urban centers to earn higher incomes. Those farmers who remain to irrigate tend to grow cash crops such as cassava and sesame, which require very little water.

This chapter begins with descriptions of wet and dry season cropping, and then examines agricultural performance in terms of cropping pattern, area planted in different crops, and yields.

A. WET SEASON PADDY

Five major varieties of paddy and a sixth category of mixed varieties that the sample farmers were cultivating were identified. These paddy varieties were broadly categorized as (1) light and medium, or (2) heavy (Appendix G).

Light and Medium Paddy. Light and medium paddy varieties have relatively short periods of growth and are harvested in November. These varieties do not grow well in deep water. The following are two major varieties of light and medium paddy grown at Lam Chamuak.

> Khaw Dawk Mali 105 (Variety 1). A non-glutinous, light variety; tolerant to stress, acidity, and salinity, and well-suited to the rainfed conditions in the northeast. In terms of grain quality, this variety is at or near the top of Thai rice varieties. It provides genes for superior grain quality and adaptation to Thai growing conditions. The local agricultural extension worker promotes this variety. (Harvested November 25.)

> Niaw San Pah Tawng (Variety 2). A glutinous (sticky), medium variety; resistant to disease. This variety is the traditional tall variety favored in the northeast.

Heavy Paddy. These are primarily non-glutinous (non-sticky) varieties, usually harvested November 26. They tolerate floods and deep water, and at Lam Chamuak they are usually grown in lowlands close to the Lam Chamuak stream. They can also grow in an area with a high water table and waterlogged soil. The following are three major varieties of heavy paddy grown at Lam Chamuak.

> Khao Pahk Maw 148 (Variety 3). A popular Thai variety; susceptible to disease. (Harvested December 3.)

Khao Tah Haeng 17 (Variety 4). Resistant to disease and insects. (Harvested December 20.)

Leuang Samuo (Variety 5). Well-suited for lowlands. Not yet extensively promoted. (Harvested second week of December.)

If farmers have highland and lowland, they often grow light and heavy varieties.

A number of other varieties were grouped into a broad sixth category, which included RD6, kruang pra-tew, leuang yai, keuang on, and khao nga changh. Category six, therefore, does not have any unique characteristics.

The research assistant identified one other paddy variety, chao sawuay, while working with case study farmers. Chao sawuay is broadcast, rather than transplanted. Farmers use this variety when they suspect that they will lack water for transplanting.

Farmers at the head of the LMC and the RMC begin planting paddy in seedbeds in July, when water is released from the tank. Farmers who grow paddy in lowlands, and who have access to natural ponds or rainwater, can begin planting paddy in seedbeds before water delivery from the Lam Chamuak tank. The research assistant reported that at least three farmers finished seed-bedding in June, prior to the tank water release. One of these three began transplanting in June.

Most tail farmers receive water after the head farmers. The Thai Korat at the tail and extreme tail usually begin planting paddy in seedbeds in August, when head farmers are transplanting. Some farmers who do not receive canal water wait for rain, dig farm ditches from natural ponds to their fields, or pump water from the natural ponds or the Lam Chamuak stream.

During land preparation, farmers need to keep about 5-10 cm of water in each parcel. Extra water is also needed when uprooting the paddy seedling to clean the roots. On average, water in the seedbeds is kept at about 15-20 cm.

In August and September, most farmers transplant. This usually takes three to twenty days depending on farm size and availability of water. After transplanting, water demand increases until flowering and harvesting.

Males prepare the land and repair the earthen bunds. Uprooting and transplanting are the responsibilities of females, although males sometimes assist females when the males' work is done.

The local agricultural extension worker recommends that farmers apply chemical fertilizer at the rate of approximately 25 kg/rai (150 kg/ha) during the seeding, growing, and flowering stages. Manure is also to be applied during the seeding stage. Lam Chamuak agricultural extension agents reported that many farmers do not use chemical fertilizers, and that those who do often do not apply it properly.

The different planting times and varieties of paddy grown mean that the stage of growth and water requirements will differ throughout the season. Farmers with adjoining paddy fields may have very different water demands at a given time.

Different varieties also mean different harvest times. Head farmers, for instance, usually grow light and medium varieties of paddy with a shorter duration of growth, which means that they can harvest during the third week in November. Tail farmers do not harvest until December.

B. DRY SEASON CROPS

RID officials estimated that approximately 20 percent of Lam Chamuak farmers cropped in the 1986 dry season. This was considered quite high compared to other years. It was the opinion of these officials that after rehabilitation and improvement, more farmers will want to participate in dry season cropping. Dry season crops in the project include sesame, cassava, sweet corn, peanuts, chilies, squashes, a few varieties of beans and melons, and other vegetables. The three major dry season crops are sesame, cassava, and vegetables.

Ethnic differences are related to crop choice in the dry season. Thai Esan at the head of the system tend to grow sesame, and Thai Korat in the middle, tail, and extreme tail tend to grow cassava. This difference is substantially due to the history, experience, personal preference, and cropping skills of each ethnic group, rather than to differences in water, capital, or soil quality.

1. Sesame

Farmers prepare their land for sesame, a cash crop, at the end of January. In February, farmers spend 10-15 days planting and caring for the sesame. Although the recommended dose of fertilizer was 25-30 kg/rai (150-200 kg/ha), the few farmers that did apply fertilizer only applied 10-25 kg/rai (60-150 kg/ha). Farmers harvest the sesame in June. Sesame requires only one irrigation, which comes during land preparation. RID officials try to provide canal water at this time.

2. Cassava

Many Thai Korat spend much of their time cultivating cassava, either on their own land or on others' fields as hired labor. After finishing seeding sesame in February, some Thai Esan also cultivate cassava.

Much demand for hired labor is generated outside of Lam Chamuak, where farmers work on larger cassava plantations. Cultivating cassava as hired labor can provide farmers with considerable income.

Cassava only requires water at harvesting to loosen the soil. Excess water can harm cassava. If a farmer has highland, he can grow cassava in both the wet and dry seasons. There is considerable highland at the extreme tail of the system, and farmers there grow much cassava. If a farmer has only lowland, cassava is only practical during the dry season. Since cassava requires up to 12 months from planting to harvesting, dry season cassava cultivation overlaps the wet season. In May, farmers clean the cassava fields of weeds. Labor for this task can be rotated year round because farmers sometimes plant cassava in different months.

3. Vegetables

Many Lam Chamuak farmers also grow vegetables on small plots of land of one rai (0.16 ha) or less, primarily for home consumption. All farmers irrigated vegetables by hand, drawing water in buckets from various water sources. Farmers at the head and middle of the system grew onion, garlic, beans, tomatoes, and chilies. Tail farmers grew the same vegetables plus cucumbers and string beans, also using water from natural and man-made ponds and the Lam Chamuak stream.

C. DRY SEASON PILOT FARM

The Department of Agricultural Extension has been urging Lam Chamuak farmers to grow more dry season crops. The Department has been working with RID to provide reliable dry season irrigation water, and the government has promoted dry season cash crops where cropping currently exists. The goals of this program are to increase farmers' income and increase yields per rai by using modern technology rather than extending the cultivated area.

To achieve these goals, the Department of Agricultural Extension, RID, and the Department of Land Development started a dry season pilot program. In 1986, local agricultural agents talked with farmers and set aside 55 rai (8.8 ha) at the head of the RMC for this experiment. Forty-three farmers agreed to cultivate the 55 rai. Each farmer was allowed to keep their produce. RID officials made certain that pilot program farmers received sufficient and reliable water. Table 73 presents the cropping pattern.

Table 73. Crops grown on dry season pilot farm in 1986, Lam Chamuak.

Crop Grown	Area (rai)
Sweet corn	18
Peanuts	15
Sesame	9
String beans	5
Chilies	5
Short bean	3

In the 1987 dry season, the government helped promote a 43-rai pilot farm at the head of the LMC. The government promoted four crops: corn, cucumber, sesame, and dry season paddy. They distributed free seeds, fertilizer, and pesticides to the farmers. Water was pumped from the main canal.

Participants in this project were selected based on interest, willingness to participate, and a history of good farming. The area cropped by each farm family was small, averaging less than 1 rai. Some participants ultimately dropped out of the program because they felt the parcels of land were too small.

D. AGRICULTURAL PERFORMANCE

1. Cropping Pattern and Paddy Varieties

Three factors tended to dominate Lam Chamuak farmers' decision-making regarding cropping patterns and the paddy variety they cultivated: ethnicity, water control, and field topography. Often these three factors were combined. For instance, degree of water control is highest at the head of the system. The Thai Esan live at the head of the system and prefer to eat light varieties of paddy. The Thai Korat are concentrated at the middle, tail, and extreme tail and primarily consume heavy paddy. Although highlands and lowlands are scattered throughout the system, the tail and extreme tail farmers had more area in highlands.

All 117 sample farmers were asked what variety of paddy they cultivated (Table 74). The data indicate that there is a relationship between degree of water control and ethnic group, and variety of paddy cultivated. The data indicate that head farmers (Thai Esan) grow variety 2, a glutinous light paddy, extensively. Variety 2 is the most popular paddy cultivated at the heads of the two main canals. Varieties 3, 4, and 5 are heavy varieties and are grown more often at the middle, tail, and extreme tail. Middle and tail farmers along the RMC also planted variety 1.

Table 74. Paddy varieties grown, by location.*

Paddy	LMC			RMC			Extreme
Varieties	Head	Middle	Tail	Head	Middle	Tail	Tail
	number of responses**						
1	1(8)	2(14)	2(25)	2(18)	4(50)	4(44)	10(37)
2	7(58)	4(29)	1(13)	5(45)	1(13)	1(11)	
3	1(8)	2(14)	1(13)		1(13)	2(22)	10(37)
4	3(25)	6(43)		4(36)	1(13)	1(11)	
5			4(50)		1(13)	1(11)	7(26)
6***	6	3	5	3	6	3	28

*Some farmers grew more than one variety on their land.
**() = Relative percent.
***Variety 6 is a combination of many minor varieties. Figures for Variety 6 were not included in percentage calculations.

The research assistant collected detailed data on paddy cultivation from the case study farmers. Three farmers at the head of the LMC grew varieties 1 and 2 only. At the head of the RMC, varieties 1 and 2 were grown in conjunction with variety 4 and another heavy variety. During his case study research, the research assistant also encountered three farmers at the LMC tail who told him that they were growing chao sawuay paddy because they lacked water for transplanting.

Note that the heavier varieties (3, 4, and 5) grown at the tail do well in deep standing water. Farmers at the tail, however, often do not receive a great deal of water. Thus, their choice of paddy varieties seem to be at least partly a matter of personal taste rather than quantity of water received.

The research assistant also discovered instances of agricultural decision-making based on field topography during his case study research. For example, at the middle of the LMC a farmer said that he grew heavy paddy varieties because of their flood tolerance. He said that his land was close to the Lam Chamuak stream and had a high water table so only heavy varieties grew well there.

Another farmer at the tail of the LMC told the research assistant that he leaves 18 rai (3.0 ha) uncultivated in the wet season because it is highland and he cannot deliver water to that field. He grows paddy on another 14 rai (2.2 ha). On 3 rai (0.5 ha), where he receives very little water, he broadcasts chao sawuay paddy. On the other 11 rai (1.8 ha), where water is slightly more abundant, he plants heavy varieties.

All 117 farmers were asked about cassava production within the command area (Table 75). Cassava cultivation was reported at every location in the system. Many farmers who said that they did not grow cassava in the command area stated that in the dry season they work on larger cassava plantations outside of the Lam Chamuak command area.

Table 75. Number of sample farmers cultivating cassava (by location) in 1986.

Cassava Cultivation	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail	Extreme Tail
	number of responses*						
Yes	6(60)	7(88)	4(44)	4(50)	8(73)	4(50)	20(32)
No	4(40)	1(12)	5(56)	4(50)	3(27)	4(50)	43(68)

*() = Percent of total responses from sample farmers at that location.

Sesame, however, seemed to be concentrated at the head of the system among the Thai Esan. The data in Table 76 confirm that sesame is an important dry season crop only at the head of the system.

Table 76. Number of sample farmers cultivating sesame (by location) in 1986.

Cultivating Sesame	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail	Extreme Tail
	number of responses*						
Yes	10(100)	3(38)	1(11)	6(75)	2(18)	2(25)	0
No	0	5(63)	8(89)	2(25)	9(82)	6(75)	63(100)

*() = Percent of total responses from sample farmers at that location.

The research assistant's investigation of the case study farmers indicates that dry season cultivation is also influenced by water adequacy. Even though cassava and sesame require little water, some moisture is needed. He talked with three farmers at the head of the LMC who normally grew sesame in the dry season, but were not growing it in 1987 because of a lack of water in the tank. (The 1987 dry season was expected to be characterized by severe drought. In fact, storage in January 1987 was 1.6 million m^3 compared to 9.5 million m^3 in January 1986.)

2. Area Cropping Pattern

In the wet season, Lam Chamuak farmers cultivate paddy on as much of their land as possible. The Department of Agricultural Extension has published the gross area of paddy cultivation from 1979 to 1983 (Table 77). Agricultural officials reported that 1983 was a particularly severe drought year. There was no explanation for the exceedingly high figures for 1980.

Table 77. Gross area of paddy cultivation in Lam Chamuak from 1979 to 1983 (Provincial Irrigation Office).

Year	Rai	Hectares
1979	5,628	900
1980	13,000	2,080
1981	5,481	877
1982	4,918	787
1983	3,790	606

The research engineer gathered data on the area of paddy cultivated in 1986. He found a total of 5,700 rai (912 ha) used for seeding or land preparation in July 1986. By the time the paddy was transplanted in August, 4,571 rai (731 ha) were under paddy cultivation. These figures correspond to the government figures for the early 1980s reported above.

All sample farmers were asked how much land they cultivated with each paddy variety (Table 78). Except for category 6 varieties, there was no large difference in land cultivated for each of the paddy varieties.

Table 78. Total and mean area of paddy cultivation in 1986 according to sample farmers (by variety and location).

Paddy Variety	Total Area rai	Total Area ha	Mean Area rai	Mean Area ha
1(n=25)	259.5	41.5	10.4	1.7
2(n=19)	257.8	41.2	13.6	2.2
3(n=17)	172.0	27.5	10.1	1.6
4(n=15)	178.0	28.5	11.9	1.9
5(n=13)	192.0	30.7	14.8	2.4
6(n=54)	705.3	112.8	13.1	2.1

Location	Total Area rai	Total Area ha	Mean Area rai	Mean Area ha
LMC				
Head(n=18)	186.5	29.8	10.4	1.7
Middle(n=17)	170	27.2	10	1.6
Tail(n=13)	133	21.3	10.2	1.6
RMC				
Head(n=14)	194	31.0	13.9	2.2
Middle(n=14)	231	37.0	16.5	2.6
Tail(n=12)	103	16.5	8.6	1.4
Extreme Tail (n=55)	747	119.5	13.6	2.2

When examining the total area cultivated with each paddy variety, the largest area cultivated was in category 6. Also, more farmers used varieties grouped in category 6 more than any other variety. If category 6 is eliminated because it is a composite of many varieties, however, the largest total area was devoted to variety 1 (259.5 rai) and the smallest area was devoted to variety 3 (172 rai).

These mean area figures (Table 78) indicate that no one paddy variety was predominantly grown at Lam Chamuak. When considering mean area, all major varieties were grown in roughly equal proportions. The data in the right half of Table 78 indicate that there was not a strong relationship between location in the system and area cultivated in paddy. The largest total area cultivated in paddy was reported at the extreme tail, but that was a result of the large number (55) of sample farmers reporting from that area. The largest mean area of paddy cultivation was in the RMC middle (16.5 rai), and the smallest mean area was in the RMC tail (8.6 rai). Although the smallest mean area was in the tail, one of the largest mean areas was in the extreme tail. These figures imply that location does not necessarily play a significant role in determining area of a farmer's paddy cultivation, given the wide range of rice varieties available from which to choose.

Sample farmers were asked about area planted in cassava (Table 79). The largest area of land planted in cassava was in the middle of the RMC (118 rai) and the smallest area was at head of the RMC (31 rai).

Table 79. Total and mean area of cassava cultivation (by location) in 1986.

	LMC			RMC			Extreme
	Head (n=6)	Middle (n=7)	Tail (n=4)	Head (n=4)	Middle (n=8)	Tail (n=4)	Tail (n=20)
	----------rai (ha)----------						
Total Area	60 (9.6)	104 (16.6)	76 (12.2)	31 (5.0)	118 (18.9)	33 (5.3)	248 (39.7)
Mean Area	10 (1.6)	14.9 (2.4)	19 (3.0)	7.8 (1.2)	14.8 (2.4)	8.3 (1.3)	12.4 (2.0)

The mean size of farmers' cassava plots seems to be related to location along the LMC, but not along the RMC. Along the LMC, mean cultivated areas under cassava increased from head to tail. The highest mean areas were at the tail of the LMC, the middles of the LMC and RMC, and the extreme tail. Tail farmers grew cassava more extensively than head farmers, at least along the LMC.

Sample farmers were asked about the area planted in sesame (Table 80). Most of the land cultivated in sesame was at the heads of the LMC and RMC. Little land was devoted to sesame at the middle and tail of the system.

Table 80. Total and mean area of sesame cultivation (by location) in 1986.*

	LMC			RMC		
	Head (n=10)	Middle (n=3)	Tail (n=1)	Head (n=6)	Middle (n=2)	Tail (n=2)
	----------rai (ha)----------					
Total Area	107(17.1)	44(7.0)	1.5(0.2)	49(7.8)	12(1.9)	2.5(0.4)
Mean Area	10.7(1.7)	14.7(2.4)	1.5(0.2)**	8.2(1.3)	6(1.0)	1.3(0.2)

*No extreme tail farmers reported sesame cultivation.

**Since only 1 farmer reported sesame cultivation at LMC tail, this really is not a mean.

Sample farmers who had not cultivated land in the wet or dry season were asked why they left the land fallow. Table 81 indicates that lack of water in itself was not an important reason for not cultivating land. The most prevalent response at all locations was personal preference. Fifty-one percent of the farmers responding stated that they wanted to leave some land uncultivated; they were not forced to do so. The opportunities for hired labor within and beyond Lam Chamuak contributes to this pattern of preference.

Table 81. Sample farmers' reasons for leaving land uncultivated (by location).

Reasons	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail	Extreme Tail
	number of responses*						
Personal preference	5(71)	5(71)	3(38)	4(57)	2(22)	2(29)	25(56)
Land inaccessible to water	2(29)	2(29)	1(13)	1(14)	2(22)	2(29)	2(4)
Lack of labor			2(25)	1(14)	3(33)		4(9)
Soil conditions			2(25)			2(29)	4(9)
Has more than one parcel of land						1(14)	5(11)
Waterlogging				1(14)	2(22)		1(2)
Lack of water							2(4)
Lack of capital							2(4)
Not applicable	3	1	1	1	2	1	18

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

Land inaccessible to water was the second most prevalent response. This response could be interpreted as lack of water, but only on highland areas. In other words, there might be adequate water from a particular water source, including canals, but the topography of the land may make irrigated agriculture impossible. There was no strong relationship between location and reported reasons for leaving land uncultivated.

A few case study farmers gave the research assistant water-related answers to the same question. Two farmers at the tail of the LMC said they did not cultivate all the paddy they wanted due to lack of water. One farmer said that he left 3 rai (0.5 ha) of land uncultivated because of lack of water. The second farmer stated that because of lack of water and field topography, he left 18 (2.9 ha) of his 29 rai (4.6 ha) uncultivated during the wet season. Note that case study farmers at the heads of the LMC and RMC and the middle of the RMC said that lack of water prevented them from growing sesame and peanuts in 1987.

Local agricultural officials stated that dry season cropping is limited because farmers do not take the time to correctly learn how to grow better or more diversified dry season or highland crops. Lam Chamuak farmers stated that they have many opportunities in the dry season to make additional income working in urban centers or on larger cassava plantations nearby. Farmers preferred to hire themselves out as laborers rather than to grow highland crops. Officials and farmers pointed out the existence of important market constraints regarding such crops.

3. Crop Yields in the Wet Season

The Department of Agricultural Extension has published the following paddy yields for Lam Chamuak (Table 82).

Table 82. Paddy yields in Lam Chamuak from 1979 to 1983 (Department of Agricultural Extension).

Year	kg/*rai*	mt/ha
1979	591	3.7
1980	528	3.3
1981	413	2.6
1982	403	2.5
1983	371	2.3

As Table 82 indicates, paddy yields declined in the early 1980s, and reports indicate that 1983 was a drought year. Nevertheless, these declining yields correspond to the declining area planted in paddy reported in Table 77 for the same years.

All 117 sample farmers were asked to estimate their paddy yields to determine if declining yields have continued through the 1980s. According to the figures in Table 83, variety 4 shows the highest mean yield of 382 kg/*rai* (2.4 mt/ha). If variety 6 is dropped, the lowest mean yield is for variety 1. The highest average yield overall for a variety or a location approximates only the lowest yields reported in the early 1980s -- Lam Chamuak paddy yields appear to continue to be low.

Note, however, that the single highest average yield reported in Table 83 is 666 kg/*rai* (4.2 mt/ha) for variety 4. This is a very adequate yield for northeast Thailand. Other individual high yields are indicated in the range category in Table 83. These figures suggest that there is potential for much higher paddy production.

Also in Table 83, yields for all paddy varieties have been averaged for each location. These data show a relationship between location and mean paddy yields; i.e., higher mean yields are at the head, lower mean yields are at the tail. The highest mean paddy yield is at the head of the RMC (362 kg/*rai*) and the lowest is at the tail of the LMC (230 kg/*rai*). In fact, two of the three highest mean paddy yields are at the head of the system, and three of the four lowest mean yields are at the tail and extreme tail of the system.

The research assistant investigated yields with the case study farmers. He found that the pattern in Table 83 was sustained by the individual cases. For instance, the single highest yield reported by case study farmers at the tail (380 kg/*rai*) was only slightly more than the lowest yield reported at the head (320 kg/*rai*).

Table 83. Mean paddy yields by location and variety, in 1986, kg/rai (mt/ha).

Paddy Variety	Range	LMC Head (n=15)	LMC Middle (n=10)	LMC Tail (n=10)	RMC Head (n=14)	RMC Middle (n=12)	RMC Tail (n=12)	Extreme Tail (n=113)	Overall Mean for Variety**
		kg/rai (mt/ha)							
1 (n=20)	80-576 (0.5-3.6)	*360(2.3)	*400(2.5)	350(2.2)	286(1.8)	244(1.5)	234(1.5)	298(1.9)	286(1.8)
2 (n=18)	66-640 (0.4-4.0)	304(1.9)	196(1.2)	*160(1.0)	492(3.1)	*444(2.8)	*320(2.0)		322(2.1)
3 (n=10)	150-468 (0.9-2.9)	*400(2.5)					358(2.2)	258(1.6)	292(1.8)
4 (n=12)	190-666 (1.2-4.2)	388(2.4)	444(2.8)		316(2.0)	*320(2.0)	*466(2.9)		382(2.4)
5 (n=10)	100-400 (0.6-2.5)			284(1.8)		*278(1.7)	*100(0.6)	380(2.4)	314(2.4)
6 (n=46)	40-560 (0.3-3.5)	258(1.6)	*500 (3.1)	144(0.9)	256(1.6)	186(1.2)	286(1.8)	270(1.7)	254(1.6)
Overall Mean for Location***		310(1.9)	344(2.2)	230(1.4)	362(2.3)	246(2.3)	284(1.8)	284(1.8)	

*n=1, therefore not a true mean.
**Average of yields from all locations for that variety.
***Average of yields for all varieties at that location.

Fertilizer use sometimes contributed to higher yields. Two farmers at the tail of the LMC reported that they cultivated chao sawuay, the paddy variety that is broadcast. One farmer did not apply fertilizer and reported yields of 140 kg/rai (0.9 mt/ha). The other applied approximately 20 kg/rai of fertilizer (the agricultural extension worker recommends 25 kg/rai of fertilizer for paddy) and had a yield of 260 kg/rai (1.6 mt/ha).

The highest paddy yield reported by the case study farmers was 480 kg/rai (3.0 mt/ha) at the head and middle of the LMC and the middle of the RMC. One of the farmers reporting these high yields said that he applied fertilizer at a rate of 22 kg/rai. However, another farmer reporting high yields said that he could get high yields without applying fertilizer.

At the head of the RMC, four case study farmers reported yields of 400 kg/rai (2.5 mt/ha). Two farmers at the middle of the RMC reported the same yields, as did a farmer at the middle of the LMC. Some of these farmers applied no fertilizer. The highest dose of fertilizer reported among these farmers was 12 kg/rai.

The lowest paddy yields reported by the case study farmers were at the middle and tail of the two main canals. The lowest yield was 80 kg/rai (0.5 mt/ha) reported at the tail of the LMC. This farmer said he had applied about 6 kg/rai of fertilizer. The next lowest yield was 120 kg/rai (0.8 mt/ha) reported at the tail of the LMC and the middle of the RMC and LMC. These farmers said that they applied no fertilizer.

The social science researchers could not confirm the farmers' figures, other than to compare them to government yield figures. The field research engineer, however, did crop cutting measurements with paddy. His results are reported in Table 84.

These figures indicate that sample and case study farmers may have slightly understated their paddy yields. All of the crop cutting yields were higher than the mean yields reported by the farmers. Only four samples were taken, and one must interpret such figures with caution. However, if these figures were valid for the entire system, it would mean that Lam Chamuak paddy yields have returned to the higher levels of the early 1980s.

Table 84. Crop cutting results from paddy samples taken in Lam Chamuak, 1986.*

Location	Variety	Yield kg/rai	Yield mt/ha
LMC head	2	495	3.1
RMC head	2	501	3.1
LMC tail	(not given)	488	3.1
RMC tail	1	467	2.9

*The moisture content of the paddy was 14 percent.

Since there were only four crop cutting observations in four different locations in Lam Chamuak, it is difficult to draw conclusions about the relationship between yields and location. Nevertheless, the above figures show little, if any, difference in yields from head to tail. More crop cutting experiments would have to be conducted to determine if any relationship exists.

4. Crop Yields in the Dry Season

The yields of two major dry season crops, cassava and sesame, were studied (Tables 85 and 86). The highest mean cassava yield was reported at the tail of the LMC and the second highest mean yield was at the tail of the RMC. The lowest mean yield was at the head of the LMC. It appears that the highest yields of cassava are at the tail of the canals. This may be due more to ethnic preferences and agricultural background than water control. Only limited water is required for cassava production, and it is the interest and experience of the Thai Korat, who live at the tail, which may largely affect cassava yields.

Mean yield figures for sesame reported by sample farmers are displayed in Table 86. (These figures should be read cautiously, as many of them are based on only one observation and are not "means.") These figures indicate that the highest yields were at the middle and head of the RMC. There is, therefore, a relationship between sesame yields and location. The single highest yield figure (28 kg/rai) was at the RMC head. As with cassava, sesame does not require a great deal of irrigation water. Differences in yield, therefore, could be attributed to the interest and experience of the Thai Esan, who grow most of the sesame in Lam Chamuak and who live primarily at the head of the system.

The field research engineer surveyed a few areas at Lam Chamuak for sesame yields. His findings differ from the yields reported by sample farmers. Throughout the system, the research engineer reported a mean sesame yield of 26.4 kg/rai. This figure is much higher than the yields reported in Table 87 by sample farmers.

The research engineer also reported that in the past few years the mean yield of sesame has been about 80 kg/rai, very much higher than either his mean yield figures or the mean yields reported by the sample farmers. The research engineer reported that 1986 sesame yields were low because of a lack of water during the first stage of growth. Sesame farmers have traditionally relied on rain during this growth stage, and in 1986, the rain was not sufficient.

Note that the extreme variation in mean yields for sesame (i.e., 8.5-15.0 kg/rai, 26.4 kg/rai, and 80 kg/rai) calls into question the accuracy of the sesame yield figures. Therefore, the mean yields for sesame reported here should be considered indicative of conditions, rather than definitive.

Table 85. Mean cassava yields in 1986 by location.

	LMC			RMC			Extreme
	Head (n=4)	Middle (n=6)	Tail (n=3)	Head (n=3)	Middle (n=8)	Tail (n=3)	Tail (n=19)
	--------	--------	--------	kg/rai(mt/ha)	--------	--------	--------
Range	500-1000 (3.1-6.3)	800-1500 (5.0-9.4)	1470-3000 (9.2-18.8)	1000-1428 (6.3-8.9)	562-3000 (3.5-18.8)	1666-2333 (10.4-14.6)	1200-2083 (7.5-13.0)
Mean Yield	781(4.9)	1055(6.6)	2157(13.5)	1276(8.0)	1581(9.9)	2000(12.5)	1584(9.9)

Table 86. Mean sesame yields in 1986 by location.*

	LMC			RMC		
	Head (n=10)	Middle (n=3)	Tail (n=1)	Head (n=6)	Middle (n=2)	Tail (n=1)
	---kg/rai (kg/ha)---					
Range	1.8-19.2 (11.3-120)	6.0-13.3 (37.5-83.1)		5.0-28.0 (31.3-175)	11-19 (68.8-118.8)	
Mean Yield	9.0 (56.3)	8.5 (53.1)	8.7 (54.4)**	13.4 (83.8)	15.0 (93.8)	10 (63)**

*None of the sample farmers in the extreme tail grew sesame.
**Since only one farmer was in this sample, this number is not a true mean.

E. CONCLUSION

This chapter examined the effect of different degrees of water control on agricultural outcomes. The data presented indicate that water control plays an important part in cropping patterns, area planted, and yields. Ethnic group differences and field topography, however, also play a large role in Lam Chamuak agriculture.

Lam Chamuak cropping patterns, and particularly the variety of paddy, are heavily influenced not only by water control, but by ethnic concentrations. Thai Esan at the head usually cultivated different paddy varieties than the Thai Korat at the tail. Likewise, the Thai Korat primarily grew cassava in the dry season, while the Thai Esan grew sesame.

The size of area planted in paddy did not seem to be related to location. Area planted in different dry season crops, however, had a strong relationship with location. Most sesame was planted at the head, and cassava was primarily found at the tail. Farmers also reported that they often leave land uncultivated out of personal preference rather than lack of water. With employment opportunities available to farmers outside Lam Chamuak, farmers are willing to forego agriculture, particularly in the dry season, for immediate cash incomes.

Finally, paddy yields seemed to be relatively low, as reported by sample farmers. Limited crop cutting experiments, however, showed significantly higher paddy yields than reported by the sample farmers. In addition, paddy yields were higher at the head than at the tail. Cassava and sesame yields seemed higher wherever farmers expressed a greater interest in these crops.

VIII. FARMERS' EXPECTATIONS AND WILLINGNESS TO PARTICIPATE IN PHYSICAL AND ORGANIZATIONAL REHABILITATION

RID and NESSI plan to extensively rehabilitate and improve the Lam Chamuak irrigation system. Construction is to begin in the fall of 1987. RID would like Lam Chamuak farmers to actively participate in this rehabilitation and improvement. (See Appendix A for farmers' initial rehabilitation activities.)

Some Lam Chamuak farmers, however, do not understand how they are to participate. Some farmers have lived at Lam Chamuak since before the irrigation system was constructed in the 1960s. They said that during construction, some farmers were hired as laborers and some obtained compensation for their land. These farmers said that they don't understand the difference between construction in the 1960s and rehabilitation in the 1980s. They have asked the social science researchers why they must devote labor for rehabilitation since they know that RID has a budget for construction.

Some newer farmers are also confused about how they are to participate in system rehabilitation and improvement. They have asked: What is the size of land they must devote to the project? What is the size of the farm ditch they are supposed to dig?

Realizing that some confusion exists, the social science researchers asked sample farmers and key informants three general sets of questions: What are farmer expectations for the system? What activities would they be willing to participate in? How could the WUA structure be changed to improve its performance?

A. FARMERS' EXPECTATIONS FOR REHABILITATION AND IMPROVEMENT

Key farmer informants were asked what their expectations were from the pending system rehabilitation. Their replies (Table 87) indicate that they are expecting specific physical improvements to the system.

The sample farmers were asked how they expect to solve problems after rehabilitation. Their responses (Table 88) are similar to the key informants' replies in Table 87 -- sample farmers' expect specific physical improvements in the system. The two most common responses at almost all locations were concrete lining of canals and ditches and solving salinity problems. Farmers at the extreme tail were particularly adamant in saying that they expect concrete lining of canals and ditches will solve their problems after rehabilitation. There is no observed relationship between expectations and location in Table 88.

Table 87. Farmer informant expectations for system rehabilitation.

Expectations	Number of Responses*
Constructing main canal overpass	23(24)**
Lining canals and ditches to prevent seepage	20(21)
Raising main canal level	15(16)
Locating turnouts at appropriate positions	12(13)
Improving feeder road	11(11)
Solving waterlogging problems	5(5)
Solving salinity problems	5(5)
Making structures to prevent sand from entering main canal	3(3)
Increasing production efficiency	2(2)

*Multiple responses allowed.
**() = Relative percent of responses.

Table 88. Sample farmers' expectations of how to solve problems after rehabilitation is complete (by location).

	LMC			RMC			Extreme
Expectations	Head	Middle	Tail	Head	Middle	Tail	Tail
	number of responses*						
Concrete lining of canals and ditches	5(50)	1(13)	6(67)	2(25)	1(9)	3(38)	51(84)
Solving salinity problems	1(10)	1(13)	2(22)	3(38)	7(64)	1(13)	7(11)
Solving water-logging problems		2(25)	1(11)		2(18)	1(13)	1(2)
Constructing overpass on main canal	1(10)			1(12)	1(9)		1(2)
Raising main canal level		1(13)		2(25)		1(13)	
Prevent seepage	1(10)	2(25)				1(13)	
Improving feeder road	1(10)					1(13)	1(2)
Installing turn-outs at proper locations	1(10)						
Improve trans-portation system		1(13)					
Not applicable							2

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

In a more informal and unstructured setting, the research assistant asked Lam Chamuak farmers what their expectations were after system rehabilitation. Again, their responses indicated a desire for physical improvements. Farmers expected:

1. Concrete lining of canals and ditches to prevent seepage.
2. Underground pipes or inverted siphons to convey water to uplands.
3. Appropriate spacing of turnouts to prevent wasting water through drainage.
4. When determining appropriate size of farm turnouts, the designers should consider seepage, number of farmers sharing water from the same turnout, and topography.
5. Sufficient canal crossings to prevent siltation of canals.
6. Solving waterlogging and salinity problems.
7. Improve feeder roads to help TOG leaders control water use.

B. FARMERS' WILLINGNESS TO PARTICIPATE IN REHABILITATION ACTIVITIES

The research assistant talked with key farmer informants and several other farmers about their willingness to participate in rehabilitation activities. Most farmers said they would participate provided it was not beyond their ability. They said they would cooperate with RID and NESSI officials in a number of activities including digging their own farm ditches with RID assistance, contributing labor for main ditch construction, grass sodding along the canal embankment, building a canal crossing, and providing wooden boards for announcements of regulations at the turnouts. Farmers also said, however, that improving the main canal is the responsibility of RID and NESSI.

Sample farmers were then asked about their willingness to participate in 11 specific rehabilitation activities, at both the main canal and farm ditch level. They were also asked who should be primarily responsible for carrying out these 11 activities. The 11 activities were as follows:

1. Devote land for construction.
2. Search for soil to fill in old canals and ditches.
3. Dig the soil.
4. Move the soil.
5. Compact the soil.
6. Search for sand to make concrete.
7. Work with concrete.
8. Search for grass to sod canal and ditch banks.
9. Move the grass.
10. Sod the canal and ditch banks.
11. Water the grass on the canal and ditch banks.

Sample farmers had clear-cut perceptions of what activities they would participate in and who should be responsible for those activities. Though not shown in a table, at the farm ditch level, 84 percent of the sample farmers said they would devote land for main canal construction. Almost all sample farmers, however, said that they were not willing to participate in the next six activities (2-7) on the main canal. Additionally, they almost all said that activities 2-7 were purely RID's responsibility.

Conversely, almost all sample farmers said that they would definitely be willing to work with grass (activities 8-11) along the main canal. They also said that farmers should be responsible for sodding activities, even along the main canal.

Based on these replies, familiarity with the work may be important to gaining farmer participation. Since farmers are familiar with working with grass, they are willing to participate in sodding the main canal. Though they could also work with soil, they feel that the main canal work should be done by RID.

Sample farmers were also asked about their willingness to participate in the 11 rehabilitation activities along their farm ditches. Again, almost all farmers said they would devote land to ditch construction. For soil and concrete work, however, (activities 2-7) their responses were more varied (Table 89).

The data in Table 89 show that the LMC and RMC farmers are either ambivalent or not willing to search for and move soil (activities 2 and 4) to fill in old farm ditches. These are new activities involving new farm ditches. Lam Chamuak farmers may not yet be willing to participate in entirely new activities.

All LMC and RMC farmers, however, regardless of location, seemed very willing to dig soil (activity 3) along their farm ditches. Lam Chamuak farmers participate in this sort of activity every year during farm ditch maintenance, so it is not surprising to find that they would continue to do so.

In regard to compacting soil (activity 5), there was a relationship between location and willingness to participate. Head farmers along the LMC and RMC were more willing to participate than tail farmers, who expressed very little desire to participate. Head farmers may see an advantage to compacting soil along their farm ditches that tail farmers do not perceive.

The last two activities in Table 89 involve concrete work. Almost all LMC and RMC farmers said they don't want to search for sand to make concrete. Conversely, most of them said that they would work with concrete. Working with concrete along their farm ditches would give the farmers a direct benefit. Additionally, farmers know that the farm ditches are theirs, not RID's, and they are usually willing to do more work along their farm ditches than along the main canals.

The data in Table 89 also indicate that the extreme tail farmers are willing to participate in searching, moving, compacting, and digging soil. The extreme tail farmers may perceive that participating in these activities will give them better water control and a chance to receive canal water. Like the LMC and RMC farmers, however, the

Table 89. Sample farmers' degree of willingness to participate in soil and concrete rehabilitation (activities 2-7) on field ditches (by location).

Degree of Willingness to Participate in Activities 2-7(%)	LMC Head	LMC Middle	LMC Tail	RMC Heads	RMC Middle	RMC Tail	Extreme Tail
	---------------number of responses*---------------						
2. Search for soil to fill in old ditches							
100	5(50)	3(38)	1(13)	3(38)	3(27)	3(38)	43(69)
75	2(20)						
50			1(13)			1(13)	
25							1(2)
0	3(30)	5(63)	6(75)	5(63)	8(73)	4(50)	18(29)
Not applicable			1				1
3. Dig soil							
100	8(80)	5(63)	5(63)	7(88)	7(64)	4(50)	46(75)
75	1(10)	2(25)	1(13)		1(9)	1(13)	1(2)
50			1(13)				
25						1(13)	1(2)
0	1(10)	1(13)	1(13)	1(13)	3(27)	2(25)	13(21)
Not applicable			1				2
4. Move soil							
100	1(10)	1(13)			1(9)	1(13)	37(61)
75	3(30)	1(13)	1(13)	1(13)			
50	4(40)	1(15)	3(38)	2(25)	3(27)	2(25)	3(5)
25				3(38)		1(13)	2(3)
0	2(20)	5(63)	4(50)	2(25)	7(64)	4(50)	19(31)
Not applicable			1				2
5. Compact soil							
100	4(40)	1(13)		4(50)	2(18)	1(13)	38(62)
75	3(30)	1(13)	1(13)	1(13)	1(9)		
50	2(20)	1(13)	1(13)		2(18)		
25							1(2)
0	1(10)	5(63)	6(75)	3(38)	6(55)	7(88)	22(36)
Not applicable			1				2
6. Search for sand for concrete work							
100	2(20)		2(22)	5(63)	2(18)	4(50)	13(22)
75							
50			1(11)				
25					1(9)		1(2)
0	8(80)	8(100)	6(67)	3(38)	8(73)	4(50)	46(77)
Not applicable							3
7. Work with concrete							
100	5(50)	4(50)	5(56)	6(75)	7(64)	4(63)	1(2)
75	3(30)	2(25)	1(11)	1(13)	3(27)	1(13)	2(3)
50	1(10)		2(22)			1(13)	44(72)
25							2(3)
0	1(10)	2(25)	1(11)	1(13)	1(9)	1(13)	12(20)
Not applicable							2

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

extreme tail farmers expressed little willingness to search for sand to make concrete, though about half appeared willing to work with concrete.

Sample farmers were also asked who should be responsible for rehabilitation activities 2-7 along the farm ditches (Table 90). Their responses correspond to their willingness to participate (Table 89); that is, farmers are willing to participate when they feel the activity is their responsibility. Though not shown in Table 90, almost all farmers at all locations said that they would be 100 percent willing to search for, move, plant, and water grass along their farm ditches. They also said that these sodding activities should be the responsibility of the farmers.

In most of the activities listed in Tables 89 and 90, farmers appeared willing to participate in rehabilitation activities when at least one of three factors was present:

1. They were familiar with the work.
2. They felt that the activity would benefit them.
3. The activity would take place on their land, not RID's.

C. PROPOSED CHANGES IN THE LAM CHAMUAK WUA

Earlier in this report when describing the social organization of irrigation, data were presented outlining some of the perceived problems with the Lam Chamuak WUA. Some of the perceived problems were that the WUA is too large and lacks coordination in implementation. Key farmer and RID informants said that structural and operational problems plagued the WUA.

Farmers and RID officials, however, have looked to the future regarding the WUA and TOGs. Both officials and farmers have specific ideas about how to solve organizational problems within the WUA. Key RID informants had four suggestions for WUA improvement:

1. Reorganize the WUA by decentralizing. TOG leaders should be given more power and responsibility.

2. Increase the number of WUA committee members and develop a clear-cut division of labor.

3. Water users should be better organized around the TOG, rather than the WUA.

4. The WUA should be combined with the <u>tambon</u> council (local administrative and political unit).

Key farmer informants and sample farmers were also asked whether the WUA should change its structure by combining with the <u>tambon</u> council or whether decision-making should be decentralized into smaller subgroups within the WUA.

Table 90. Sample farmers' opinions of who should be responsible for soil and concrete rehabilitation (activities 2-7) along farm ditches (by location).

Responsibility	LMC			RMC			Extreme
for Activities 2-7	Head	Middle	Tail	Head	Middle	Tail	Tail
	---number of responses*---						
2. Search for soil to fill in old ditches							
Farmers	6(60)	3(38)	2(25)	3(38)	3(27)	2(29)	40(75)
RID	3(30)	5(63)	5(63)	5(63)	8(73)	4(57)	13(25)
Farmers & RID	1(10)		1(13)			1(14)	
Not applicable			1			1	10
3. Dig soil							
Farmers	8(89)	4(50)	5(63)	7(87)	6(55)	4(50)	43(80)
RID		1(13)	1(13)		3(27)	2(25)	10(19)
Farmers & RID	1(11)	3(38)	2(25)	1(13)	2(18)	2(25)	1(2)
Not applicable	1		1				9
4. Move soil							
Farmers	1(10)	1(13)			1(9)	1(13)	34(65)
RID	2(20)	5(63)	4(50)	1(13)	7(64)	4(50)	14(27)
Farmers & RID	7(70)	2(25)	4(50)	7(87)	3(27)	3(38)	4(8)
Not applicable			1				11
5. Compact soil							
Farmers	4(44)	2(25)		4(50)	2(18)	1(13)	35(67)
RID		5(63)	6(75)	2(25)	6(55)	7(87)	17(33)
Farmers & RID	5(56)	1(13)	2(25)	2(25)	3(27)		
Not applicable	1		1				11
6. Search for sand for concrete work							
Farmers	1(11)		1(11)	5(63)	2(20)	4(50)	16(28)
RID	7(78)	8(100)	6(67)	3(38)	7(70)	4(50)	41(72)
Farmers & RID	1(11)		2(22)		1(10)		
Not applicable	1				1		6
7. Work with concrete							
Farmers	1(11)	3(38)	3(33)	3(38)	4(36)	4(50)	2(3)
RID		2(25)	1(11)	1(13)	1(9)	1(13)	10(17)
Farmers & RID	8(89)	3(38)	5(56)	4(50)	6(55)	3(38)	47(80)
Not applicable	1						4

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

1. Tambon Council

Farmer informants were asked if the WUA would function better if it was combined with the _tambon_ council or another existing group. Their responses (Table 91) indicate that over three-quarters of the key farmer informants do not want the WUA combined with the _tambon_ council.

Table 91. Farmer informants' opinions of combining the Lam Chamuak WUA with the _tambon_ council.

Questions Asked of Farmers	Number of Responses*
Will WUA function better if combined with _tambon_ council?	
No	27 (79)
Yes	7 (21)

Why would it not function better? (n=27)

* Those who have never received water are not interested in WUA.
* Those who do not stay in project area are not interested in this group.
* Work would be complicated.
* Group control is difficult.
* The nature of the work is different.
* _Tambon_ council already has much work to do.
* Organizing only water users is much easier.

Why would it function better? (n=7)

* Cooperation among group members leads to strong group action.
* Group would be strengthened because _tambon_ council has decision-making power.
* Coordination among WUA members would be better because _tambon_ council's meetings are important and they disseminate information.
* Rules can be enforced.

*() = Percent of total responses.

Those who do not want this combination said that the interests and work of the WUA and the _tambon_ council differ, and these differences would make the WUA more difficult to manage, not less. The comparatively few key informants who did want the merger said that it would give the WUA the power to deal more effectively with irrigation issues.

Sample farmers were also asked if the WUA would work better if combined with the _tambon_ council. Their responses (Table 92) indicate a very clear difference between LMC and RMC farmers and extreme tail farmers. The LMC and RMC farmers, regardless of head or tail location, said that the WUA and _tambon_ council should be kept separate. Farmers at the extreme tail felt just as strongly that the two organizations should be merged.

Table 92. Sample farmers' opinions of combining Lam Chamuak WUA with the *tambon* council (by location).

Combine WUA with Tambon Council?	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail	Extreme Tail
	number of responses*						
Yes, council has authority to control and make decisions.	1(11)		1(13)	2(25)			23(46)
Yes, people believe and respect council.							22(44)
Yes, local leaders on council understand farmers' problems.			2(25)		1(9)	1(13)	3(6)
Yes, council can better solve problems at monthly meetings.			1(13)				
No, they are different and have different work.	2(22)	5(63)	2(25)	3(38)	8(73)	5(63)	2(4)
No, because they are busy with their own work.	6(67)	3(38)	2(25)	3(38)	2(18)	2(25)	
Not applicable	1		1				13

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

2. Subgroups

Officials and farmers were asked about breaking the WUA into smaller subgroups. Farmer informants' were asked whether or not the WUA should be broken into subgroups (Table 93). All but two key informants said yes. Almost all of the key informants who advocated breaking the WUA into subgroups said that the existing TOGs should be the base for the new subgroups. The RID informants made the same suggestion (Table 93). Both farmer and RID key informants, therefore, want to keep the basic structure of the Lam Chamuak irrigation organization, but devolve more power and responsibility to the TOGs.

Sample farmers were also asked what the best subgroups would be if the WUA was divided. The most preferred option was head and tail subgroups (Table 94). Only at the head of the LMC did less than half of the farmers choose head and tail subgroups.

Table 93. Key farmer and RID informants' opinions on whether or not the WUA should consist of subgroups.

Questions Asked of Key Informants	Number of Responses*
Farmer key informants:	
Break WUA into subgroups?	
Yes	32(94)
No	2(6)
If yes, how?	
TOGs, as the existing ones	28(88)
Head and tail groups	3(9)
LMC and RMC groups	1(3)
RID key informants:	
What would be the best subgroups?	
TOGs, as the existing ones	7(64)
LMC and RMC groups	3(27)
Head and tail groups	1(9)

*() = Percent of total responses for that question.

Table 94. Sample farmers' opinions on the best potential subgroups for WUA (by location).

Potential Subgroups	LMC Head	LMC Middle	LMC Tail	RMC Head	RMC Middle	RMC Tail	Extreme Tail
	number of responses*						
Head and tail	1(11)	4(50)	5(56)	7(88)	7(70)	6(75)	56(93)
TOGs	4(44)	4(50)	2(22)		3(30)	1(13)	2(3)
LMC and RMC	3(33)		1(11)	1(12)		1(13)	2(3)
Head, middle, tail	1(11)		1(11)				
Not applicable	1				1		3

*() = Percent of total responses from sample farmers at that location, excluding "not applicable" responses.

The research assistant found sentiment for head and tail subgroups particularly strong at the tails of the main canals. Tail farmers told him that a WUA composed of head and tail water user groups would enhance the WUA's capacity to control the water use of its members. It would also help improve communication between members and between groups. Additionally, the tail group of farmers might have some bargaining power for water with the head farmers.

The sample farmers' preferences for subgroups differs from the key informants. Key informants chose to strengthen the existing TOGs. The sample farmers preferred new subgroups based on head and tail locations.

D. CONCLUSION

Farmers have clear expectations and ideas about their participation in the coming Lam Chamuak rehabilitation and improvement program. They expect physical improvements in the system; most notably: lining the canals, constructing overpasses, and locating turnouts at more appropriate locations. It is not clear whether or not RID and NESSI have talked with the farmers regarding how many of their expectations can be reasonably met.

Farmers are willing to devote land and labor to RID and NESSI if it will improve the irrigation system. They clearly indicated, however, that they consider some activities to be the responsibility of RID, and that they would take responsibility for other activities that they are familiar with, that directly benefit them, and that take place on "their" land, not RID's.

Almost all farmers and key informants wanted to decentralize the WUA to make it more responsive to farmers and TOGs. Farmers have already attempted to devolve power from the WUA to main canal committees and TOGs.

IX. SUMMARY

This research report has examined how the social organization of irrigation affects farmers' water control and how water control affects agricultural outcomes in the Lam Chamuak irrigation system. The manner in which farmers and RID officials organize to accomplish the tasks of an irrigation system directly bear on farmers' control of water. Where water control is lacking, agricultural production will also suffer. However, water control appears in several forms at Lam Chamuak -- canal flows, stream flows, ponds, and mini-reservoirs.

Location plays a significant part in determining a farmer's canal water control in Lam Chamuak. Farmers at the head of the main canals have more canal water control than farmers at the tail, and farmers along the RMC have better water control than farmers along the LMC. Indeed, the degree of farmer canal water control at Lam Chamuak seems to be based on three locational factors: location on the left or right bank main canals, head to tail location on either main canal, and head to tail location on secondary turnout ditch. Farmers at disadvantaged locations do not receive adequate and reliable canal water when they need it.

Head farmers (most of whom are Thai Esan) were at a more advantageous location than farmers at the tail (most of whom are Thai Korat). The WUA president is Thai Esan, and he lives in the Thai Esan village at the head of the system. He is actively involved in water allocation and distribution. There was a lack of effective mid-level organization to coordinate farmers' demand for water with main system supplies and to adequately sustain maintenance.

Various physical and operational problems contribute to the farmers' lack of canal water control. Sediment, damaged canals, inappropriate turnout locations, lowlands, lack of water, and lack of effective organizational rules fitted to physical control structures are all problems identified by Lam Chamuak farmers and RID officials. These problems reduce farmers' water control and contribute to irrigation behavior such as detrimental checking of the main canals and farm ditches, constructing unauthorized turnouts, and breaking canal walls. These actions increase water control for some farmers, but decrease it for others.

Data reported indicate that farmers will participate in maintenance activities when they see a direct benefit for themselves (i.e., when maintenance is directly connected to water allocation), and that effective leadership supported by farmer-sanctioned rules and tools is important in mobilizing farmers. Currently, TOG leaders organize farmers for regular maintenance, while the WUA president mobilizes farmers for emergency maintenance. The RMC was generally in better physical condition than the LMC, which was at least partially due to stronger, more active TOG leaders along the RMC who were supported by farmer conceptions of more appropriate agreements about water direction and maintenance.

Lam Chamuak farmers used a number of different water sources. Some of these sources (e.g., "mini-scale" irrigation projects) were more important to the farmers than canal water, particularly at the tail and extreme tail of the system. Some of the sources employed at the tail, however, (e.g., natural ponds) were not convenient and required farmers to use extra labor or a pump. Canal water was often the most convenient, especially for head farmers.

Farmers from outside the command area have tapped into water supplies. A large group of farmers uses water from the tank in the dry season, and another smaller group near the tail of the LMC takes water from the main canal. These groups, knowing they had no choice but to be self-reliant, devised clear organizational rules to operate their physical tools in the service of specified water shares and to control "free riders."

Location in the system is directly related to water control. Head farmers had better water control than farmers at the tail, and the RMC farmers appeared to have better control than the LMC farmers. Physical and operational factors -- sediment, damaged canals, land inaccessible to water, inappropriate turnout location, and lack of mutually agreed-upon rules -- contributed to poor water control in many parts of the system, particularly the tail.

Paddy yields were directly related to water control. Farmers at the head, with the best water control, had the highest paddy yields, while farmers at the tail, with poorer water control, produced the lowest mean yields. Yields of dry season crops were related to farmers' interest and enthusiasm for the crop. Farmers who traditionally are involved in sesame cultivation, for instance, usually had higher mean sesame yields than farmers who were not familiar with the crop.

Farmers and officials made it clear that they preferred a decentralized Lam Chamuak WUA. Farmers have made efforts to change the structure and operations of the WUA so that it is more responsive to farmers' needs.

As RID and NESSI proceed with the rehabilitation and improvement of Lam Chamuak, it would be well to keep in mind the importance of rehabilitating and improving the social organization of the Lam Chamuak irrigation system. If only physical rehabilitation and improvement takes place, it is likely that farmer water control will not be sufficiently improved, leading to further irrigation and agricultural problems. The problem of organizational breakdown (discussed in Volume 1 of this series) proceed from an only temporarily improved physical base, which will soon erode again.

However, local organizations appropriately designed around viable staffing patterns, authority relationships, water distribution (share) arrangements supported by physical structures which can implement the social rules are feasible at Lam Chamuak. There appears to be no compelling obstacles to designing and implementing improved local organizational arrangements as outlined in Volume 1.

X. APPENDICES

APPENDIX A
ICO ACTIVITIES AT LAM CHAMUAK

OCTOBER 1985 LAM CHAMUAK WORKSHOP

In October 1985, a two-week farmer participation project implementation workshop was held at Lam Chamuak. Workshop participants were from RID, NESSI, and Kasetsart University. The objectives of this workshop were to (1) conduct a rapid appraisal of the irrigation system to tentatively identify the strengths and weaknesses of the system, (2) search for potential solutions to the system's problems, and (3) identify priority research needs. The workshop also provided the opportunity for all project personnel to meet and plan together for the first time.

During this workshop, interdisciplinary teams conducted a rapid appraisal of Lam Chamuak. The teams identified two major strengths and two major weaknesses. The first major strength was the presence of established irrigation organizations that could be improved and built upon. The existing water users' association and TOGs performed some useful functions including conducting public meetings for information purposes and collecting and distributing money for needed travel expenses.

The second major strength identified was the expressed willingness of Lam Chamuak farmers to participate in system improvements. The Lam Chamuak social structure, including population characteristics and landholding patterns, did not appear likely to hinder improved organizational activities. Farmers' attitudes also appeared conducive to effective participation.

More importantly, the farmers' behavior indicated that effective participation and organizational behavior already existed at Lam Chamuak. In the local communities, farmers work together to construct temples, roads, bridges, and roadside rest areas. The work is often supervised by Buddhist monks, who have taken a lead in development activities. Along some turnouts, farmers have worked together to clean not only the ditches, but occasionally the main canal as well. Some TOG leaders also stated that farmers also cooperate in distributing water.

The Parsons-Team Consultant Task Force (1985)* studied Thai irrigation systems. They concluded that Lam Chamuak farmer institutions were stronger than in other NESSI sites and that there was a high rate of farmer participation. The task force stated that farmers had a positive attitude towards participation and "...it should not be difficult to induce them to participate more in irrigation." Other

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*Parson-Team Consultant Task Force. 1985. Special report on socio-economic conditions: Huai Chorakhe Mak, Huai Talad, and Lam Chamuak. p. LC-32.

researchers from the Asian Institute of Technology in Bangkok researched the Lam Chamuak area and concluded that active participation is prevalent at Lam Chamuak. The researchers said that Lam Chamuak has the kind of potential that project planners are always looking for.

The rapid appraisal teams also identified at least two serious weaknesses in the system. First, there appeared to be an organizational breakdown in the present farmers' irrigation groups. There were no widely accepted, well-known rules or regulations for system operation and maintenance. The association appeared to have no written, or even informal, rules and regulations for behavior, and its purpose was vague to most farmers. The association had form, but no function. Neither the farmers nor the officers were sure what their roles should be. Most irrigation activities were performed ad hoc. Farmers also complained that the association was too big and unresponsive to their needs. Pengsawang (1982)* also reported that the Lam Chamuak water users' association is not functioning properly.

There also appeared to be a lack of communication and knowledge within the farmers' groups, and between the groups and irrigation authorities. Most farmers contacted did not know who the association officers were, and the officers did not know the farmers. The election of officials primarily involved only one or two villages. Irrigation officials also lacked knowledge of farmers and farmers' groups.

Another major weakness identified was the unreliable and inequitable distribution of irrigation water. The teams' observations and farmers' reports indicated that the tail of Lam Chamuak rarely received canal water and suffered as a result. Indeed, the last 4.0 km of the right main canal has never been used and the canal is completely overgrown with vegetation. It is almost impossible to find the tail portions of the main canals. One farmer in the middle of the system called the canals "air canals," as they only carried air, not water.

The farmers also reported that the people owning land close to the canals would often not allow water to pass through their fields to other fields lower in the system. Thus, field-to-field irrigation appeared to contribute to inequitable water distribution.

There were also reports of considerable water theft throughout the system as farmers struggle to obtain water for their fields. A number of short-term conflicts result, and farmers guard their water at night, particularly during times of water scarcity.

Based on these findings of system strengths and weaknesses, the workshop participants developed a farmer participation and organizational strategy for Lam Chamuak based on implementation and research. The core of the implementation strategy was to develop a cadre of ICOs (irrigation community organizers). These "catalyst agents" would be

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*Pengsaweng, P. 1982. Problems of water use and water management in northeast Thailand: a case study of Huai Lam Chamuak Irrigation Project. Bangkok, Thailand: Asian Institute of Technology. [Thesis.]

young men and women trained in basic organizational and water management techniques. They would live in Lam Chamuak villages and help farmers built their own effective irrigation organizations. The IOOs would not become leaders of these organizations, but would encourage farmers to develop their own associations and rules. (Such a strategy employing catalyst agents is currently in use in the watershed Mecham Project in northern Thailand.) A specific IOO workplan would be developed in November and December of 1985.

The farmer organizations would be responsible for working with NESSI officials in the pre-construction stage of the Lam Chamuak improvement program. Later, they would participate in decison-making during the construction and O&M phases of the project.

During the search for solutions phase of the workshop, participants identified activities that would be the exclusive responsibility of RID and NESSI, the exclusive responsibility of farmers and their local organizations, and the joint responsibility of RID, NESSI, and the farmers.

The workshop participants also developed some general guidelines for research. One high level RID official stated that Thailand has always lacked written documents on how projects have been implemented. Therefore, he stated, Thailand has never been able to learn from its own experience. Consequently, the research should generate valuable data that project personnel could use as part of a "learning process," such as Korten (1980)* describes.

Participants decided that five Thais would be involved in data collection and analysis. Two junior engineers, supervised by a field research engineer, would devote 100 percent of their time to the project. The field research engineer would devote 50 percent of his time to the project. A social science research assistant would live at the site full time, supervised by a senior social science researcher, who would devote 50 percent of her time to the project.

The general workplan developed at this workshop called for the formation of a site coordinating committee, which would meet at Lam Chamuak once a month. This committee would be a working team of project implementors and researchers, including the regional and provincial RID project administrators, the NESSI project field manager, and sometimes RID's director of O&M.

The original plan also proposed that the site coordinating committee would be supervised by a project advisory committee, which would meet in Bangkok the last of each month. This second committee proved to be a burden for many participants, however. Decision-making was transferred to the site coordinating committee meetings at Lam Chamuak.

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*Korten, D.C. 1980. Community organization and rural development: a learning process approach. Public Administration Review. pp. 480-511.

ICO RECRUITMENT, TRAINING, AND WORKPLAN

In November 1985, RID's provincial irrigation engineer published announcements of ICO employment opportunities in local Thai newspapers, radio, and at the provincial irrigation office. Because the project had to begin in December 1985, the announcements were run for only two weeks. This limited the time that RID and Dr. Kanda Paranakian (senior social science researcher) could spend in selecting potential ICOs.

Despite the short time, 63 candidates submitted applications. Eight ICOs were selected. These were four young RID employees, all males and graduates of vocational schools, and four young female college graduates with no RID background. Officials told the four female ICOs that they would be paid by RID and NESSI, but they would be temporary RID employees.

As RID had never conducted an ICO training program before, they contracted with NIACONSULT in the Philippines for a training consultant. NIACONSULT is associated with the Philippines' National Irrigation Administration. It has years of experience training young men and women how to help farmers organize water users' groups.

On November 16, Ms. Victoria Pineda of NIACONSULT arrived in Thailand. She spent a week in Bangkok with RID training officials and Dr. Kanda developing an ICO training schedule, a course curriculum, and materials. From November 26 to December 7, 1985, RID and NESSI officials, Dr. Kanda, and Ms. Victoria Pineda conducted the ICO training at Lam Chamuak. The first part of the training program covered basic community organization concepts, principles, and processes; fundamental ICO skills required; key issues in developing water users' groups; and the roles and responsibilities of ICOs.

Each ICO was then asked to spend 6 days with Lam Chamuak farmers. The ICOs were to live in a Lam Chamuak village and talk to as many farmers as possible, gathering data about Lam Chamuak irrigation and organizational activities. At the end of the 6 days, the ICOs were to discuss their experiences and consolidate their data.

The final activity in the training workshop was to develop a nine-month ICO workplan for Lam Chamuak. The training staff decided that it would be impractical to make detailed plans more than 9 months in the future. The workplan was a group effort, with much input from the ICOs and the RID training staff. The workplan included activities, people, time frames, and expected outputs. The general thrust of the ICO workplan was to post ICOs at the site, have them discuss with farmers the proposed NESSI improvements at Lam Chamuak, and have them encourage farmers to form effective organizations so that they could become involved in improvement efforts. The ICO workplan was printed on large poster paper and prominently displayed at the Lam Chamuak ICO office.

ICO ACTIVITIES IN 1986

LIVING ARRANGEMENTS

In December 1985, the eight ICOs were posted at Lam Chamuak. For the first few weeks, the ICOs preferred to live together in one location. Initially, therefore, seven of the eight ICOs lived with the president of the existing WUA. Additionally, the president was protective of the four female ICOs, as it is unusual to have single females working alone in rural Thailand. Later, the ICOs realized that living at the president's house meant that their independence could be questioned.

For the first month, the president accompanied the ICOs to Lam Chamuak villages and farms, introducing the ICOs to the farmers. Most of the time, however, the WUA president did all the talking and the ICOs simply took notes. The ICOs did not have motorcycles and their mobility was limited.

As the ICOs became more familiar with the area, they realized that they should live apart from the WUA president. They needed to meet and establish credibility with the farmers on their own. Therefore, most of the ICOs finally left the president's house to find living quarters with farm families throughout the command area. One ICO stayed at the president's house to be close to his assigned area.

The ICOs reported that they got to know the farmers quite well by living with them, but financial arrangements for living expenses were a problem. There was confusion concerning how much money the ICOs should contribute to household expenses. Also, the ICOs felt that they were imposing on the farmers' hospitality. The female ICOs were particularly uneasy because sometimes the ICOs attended late night TOG meetings. When they returned to the farmer's house, they had to knock on the door and awaken the family to come inside. After 6 months, the ICOs rented separate houses and rooms in Lam Chamuak villages. This arrangement proved satisfactory.

One ICO, however, was married and wanted to be closer to his family in Korat, about 80 km to the west. When his work prevented him from going to Korat, he became concerned about his family's welfare. This legitimate concern meant that this ICO spent his weekends in Korat. He never established a semi-permanent residence at Lam Chamuak. (Later on, all ICOs agreed that single people make the best ICOs.)

ICOs' PRELIMINARY ACTIVITIES

The sequence of ICO activities was outlined systematically in the ICO workplan developed by RID and Victoria Pineda during the ICO training. The first activity was integration into the community. It was felt that the ICOs needed to become a part of the Lam Chamuak community by living and working with farmers.

In reality, the first substantive ICO activity was to conduct a complete enumeration of Lam Chamuak farmers. The RID supervisors of the ICO program stated that they needed to know who was farming in the command area. This knowledge would help them plan the future rehabilitation and improvement program. These officials also hoped that the survey would help the farmers and the ICOs meet and become acquainted with one another.

Some ICOs, however, felt that the survey of water users interfered with their integration into the community. Rather than getting to know villagers well, the ICOs had to briefly meet as many farmers as possible and ask them short questions. Though the ICOs did see all parts of the system, there was no time to become acquainted with the villagers or to fully explain to them what an ICO was.

These initial efforts, therefore, were sometimes confusing and difficult for the ICOs and farmers. The ICOs' role was new and not yet sharply defined. Farmers were skeptical. Though RID informed the local administrative authorities about the ICOs' presence and work, the authorities were unsure why the ICOs' were at Lam Chamuak. Local village leaders often accompanied the ICOs to meet other farmers and explain the ICOs' presence in the village. It took at least 3 months for the initial confusion to end.

The ICOs first major irrigation activity was to help farmers revitalize their existing, but moribund, turnout groups (TOGs). If this proved impractical, the ICOs were to encourage farmers to form new TOGs. TOGS already existed on paper, as did the Lam Chamuak WUA. Over the past 10 or 15 years, however, they ceased to function. Reviving or forming new TOGs was vitally important as these groups would be the vehicle for meaningful farmer participation at Lam Chamuak.

The ICOs' strategy was to meet the farmers along each turnout. The ICOs asked each set of farmers to identify potential leaders for TOGs. The ICOs then asked the potential leaders to organize meetings with the other farmers along the turnout.

This sometimes dreary, but necessary, organizational work was done through the winter and spring of 1986. It was the dry season when only 10-20 percent of Lam Chamuak farmers irrigate. Unfortunately for the ICOs' work, some farmers leave Lam Chamuak in the dry season to seek non-agricultural labor outside the system. Others grow upland crops (cassava) on land they own outside Lam Chamuak, and they are often absent.

The ICOs did not yet know the community and the farmers very well, and took a great deal of time to contact farmers throughout the system. Farmers were scattered in villages and sometimes were not at home or in their fields when the ICOs arrived. The ICOs quickly discovered that they often had to make appointments to see farmers, or had to catch them early in the morning or in the evening. Despite these logistical problems, the ICOs were able to contact farmers on all 51 turnouts along the left and right main canals.

In general, the initial informal TOG meetings were successful. Of 503 TOG members, the ICOs counted 463 members (92 percent) who attended. At the TOG meetings, the ICOs talked with the farmers about NESSI's proposed rehabilitation plan and urged farmers to become effectively involved in the pre-construction, construction, and O&M stages. The ICOs told the farmers that RID and NESSI sincerely wanted their ideas and participation in this project. The TOGs and WUA would be the key link to RID and NESSI. A few times NESSI engineers accompanied ICOs to these meetings to lend credence to the talk of system rehabilitation and improvement.

During these group meetings, the farmers and ICOs discussed irrigation problems, how future group meetings should be held, and the willingness of farmers to participate in the proposed system rehabilitation. Most farmers at these meetings stated that they would cooperate with RID and NESSI to rehabilitate the system. At least initially, the farmers said they would help RID plant grass along new canal banks to prevent erosion, give up portions of their land for construction of farm and main ditches, contribute labor for farm ditch construction, and write any TOG rules and regulations on wooden boards at the turnouts.

ICOs particularly stressed the need for the TOGs to develop new rules for irrigation or to enforce existing rules. It was important that each TOG develop its own rules, so that the groups would truly be farmers' groups, not RID groups. The rules and their enforcement would be the rationale for the TOG. In principle, the TOGs would then deliver to the farmers something they lacked -- predictability and better water control.

Often using their own initiative, farmers in TOGs formulated rules and regulations for water distribution and maintenance. Fines were agreed upon for those breaking the rules. Some TOGs developed rules for membership, requiring everyone who used canal water, whether a farmer or not, to join the TOG. Many TOGs along the right main canal developed a rule that vegetables could no longer be grown along canal banks as that caused soil erosion and increased the sediment in the canals. One TOG insisted upon a 30 baht fine for those breaking the rules; another demanded 50 baht. Farmers then monitored compliance with these rules.

WMSII personnel tried to monitor the organizational effort at Lam Chamuak. Short visits were made to Lam Chamuak in January, March, and June of 1986, usually while the WMSII staff member was on his way to another country in Asia. One WMSII staff member observed a farmers' meeting with ICOs when rules were being debated and developed. After the rules had been accepted, the farmers signed the set of regulations they had worked out with the ICOs. The farmers laughed when they signed the rules. The WMSII staff member asked why they were laughing. Dr. Kanda was present and told him that one of the farmers had said they might have to sell all their buffalo to pay the fines.

During the organizational meetings in the dry season, farmers had many questions. When will construction for rehabilitation begin? Can farmers apply for jobs during construction? Will turnouts be enlarged? Will farmers from outside the command area be allowed to pump water from the main canals if they are willing to participate in the system rehabilitation?

Often the ICOs did not have answers to these questions. Their training contained little information regarding the proposed NESSI rehabilitation and improvement plan. Some farmers even complained that ICOs told them that the construction schedule was a secret and could not be revealed to the farmers. Mostly, however, the ICOs told the farmers they did not know the answer to these questions, but said they would try to find out.

Some of the questions were answered at the monthly site coordinating committee meetings at Lam Chamuak. ICOs, Dr. Kanda, the engineering and social science researchers, and RID and NESSI officials attended these meetings to discuss their work and plan any changes in their activities.

However, NESSI officials were sometimes unable to answer specific questions about the construction schedule and plan. Since NESSI did not have its FY1987 budget approved by the Thai Parliament in Bangkok, the NESSI officials were unsure about the exact details of the construction plan and schedule.

NEW DESIGN FOR LAM CHAMUAK

NESSI officials told the ICOs that construction would probably begin in 1987. In March 1986, the tentative new design called for enlarging the command area from 6,000 to 13,500 rai. (This was the size of the command area originally planned in the 1960s.) The new design also called for changing the location of many turnouts and increasing the number of turnouts from 51 to 128. The number of farmers served would increase from approximately 503 to 935.*

The proposed changes in the turnouts had an immediate impact on the ICOs' activities. Until March 1986, the ICOs helped farmers revitalize the "old" 51 TOGs. Under the new design, many of the old TOGs would merge or split, and entirely new turnouts would be constructed. Before construction began in the first three units, the ICOs had to return to the farmers, explain the changes, and try to build new TOGs based on the new design.

Two ICOs made a particularly strenuous effort to help farmers form TOGs at the extreme tail of the system. Farmers in this area never received water from the Lam Chamuak tank and were skeptical that water

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*In April 1987, NESSI officials learned that two portions of the system had not been designed, which means there will be no construction in these portions. Therefore, the number of turnouts decreased from 128 to 100, and the number of farmer beneficiaries became 739. The total irrigable area will be about 12,990 rai (2,078 ha).

would reach them, even after rehabilitation. Nevertheless, the ICOs persisted at the extreme tail and did, in fact, help farmers build new TOGs.

NESSI wanted to involve farmers in the new design. They suggested to the ICOs that the farmers provide bamboo stakes and accompany NESSI technicians during the new survey, placing stakes where new turnouts and main ditches would be located. Technicians were then supposed to discuss with farmers the advantages and disadvantages of a particular turnout location and ditch alignment. The ICOs talked with the farmers, and they agreed to this plan.

END OF 1986 DRY SEASON: PROBLEMS AND PROSPECTS

TOGS. In May and June, Lam Chamuak farmers began harvesting their dry season crops and preparing the canals and ditches for the wet season irrigation beginning in June and July. The ICOs recognized that some TOGs were better organized than others and spent more time in the areas where there was more conflict and difficulty with organizational work.

The ICOs were not responsible for all of the farmers' motivation to revitalize their TOGs. Much of the farmers' stimulation came from self-interest, as they realized that activities such as main ditch maintenance could be carried out more effectively by a group, than by individuals. In many cases, the ICOs simply guided or channeled the motivation that was already there. ICOs stated that they and the farmers stimulated each other to work harder.

A continuing problem during this period was the farmers' lack of information concerning system rehabilitation and improvement. Some farmers claimed that they had nothing to talk about during TOG meetings because they did not know exactly when construction would begin, how the new design would look, and exactly how farmers could participate in rehabilitation and improvement. These farmers, therefore, took a "wait and see" attitude. Other farmers said that the rules formulated at the TOG meetings might work for the dry season irrigation, but that some people would not observe the new rules when farmers desperately needed water for their wet season paddy crop.

Administration. Several administrative problems bothered the ICOs during the first 6 months of the project. ICOs sometimes received their salaries late. Reimbursements to the ICOs for motorcycle repairs also took much time.

The RID officials supervising the ICOs also had administrative problems. The ICO supervisor at Lam Chamuak had much paperwork and other RID duties. In addition, none of the ICO supervisory staff received training in this new approach, and they were often unable to guide the ICOs' work.

Research. The engineering and social science research components progressed during the dry season. Initially, however, some RID employees mistakenly believed that the social science research assistant at the site was really an evaluator "spying" on their work. These RID officials wanted the social science research assistant to report to them before every site coordinating committee meeting. It took almost 6 months of steady lobbying to convince these officials that the assistant's work was valid research, not evaluation, and that the organizational process needed to be fully documented.

The social science researchers had a dilemma when RID officials asked them to become involved in the implementation of the project. RID officials always asked the senior social science researcher how RID should work with the ICOs and farmers. However, she felt she was working as a researcher, not as an implementor. At times she found it difficult to seperate the role of researcher from the role of implementor. Eventually, RID accepted her formal role as a researcher. However, she could not totally avoid advising RID on implementation decisions at the monthly site coordinating committee meetings.

These problems did not prevent the researchers from collecting some important data at Lam Chamuak. For instance, the social science research assistant discovered a large group of farmers outside the command area, who used water from the tank, not the canals, to irrigate their fields during the dry season. These farmers had a tightly-knit organization and irrigated up to 600 rai using the tank water. Local RID officials had not stopped their activities as long as there was sufficient water in the tank. RID and NESSI, however, did not know the extent of this irrigation. When the senior social science researcher presented these findings at the monthly site coordinating committee meeting, RID and NESSI project staff discussed how this irrigation would affect the management of the system.

WET SEASON, 1986

By the beginning of wet season in 1986, farmers had participated in several maintenance activities. The ICOs stimulated the TOG leaders to mobilize labor to remove sediment and weeds in the main canals and farm ditches. Where labor was short, the president of the WUA helped mobilize labor from other villages.

Every TOG member helped to clean the main canal until it was finished. All the left main canal TOGs were divided into two groups: head and tail. All head farmers cleaned the head of the main canal and all tail farmers cleaned the tail of the main canal. The workers included male and female farmers, landowners, tenants, relatives of landowners, and hired laborers.

Some farmers complained, however, when a TOG with a small number of members had to maintain the same length of main canal as a TOG with more members. The TOG with fewer members might take 4 days to complete their work, while the TOG with more members finished in 2 or 3 hours.

Some TOGs were strict in requiring all farmers along a turnout to provide labor for maintenance. Leaders from these TOGs kept meticulous records of who contributed labor. Those farmers who were not present and could not provide an adequate excuse were fined. The social science research assistant observed many examples of TOGs actually enforcing their rules and fining farmers.

TOG 21 on the right main canal, for instance, stressed strict rule enforcement. The TOG leader called a meeting of the farmers along the turnout and set a maintenance schedule. He also reminded the members of the rules and regulations they had all agreed to in the April TOG meeting with the ICO. At that meeting, the TOG members decided that those farmers who only worked half a day would be considered absent. After the first maintenance activity in June, 14 members were either fined 30 baht/day for not participating, or they had to agree to provide double labor for the next maintenance activity.

In other TOGs there were no punishments for those who did not participate in system maintenance. In these TOGs, some members hired labor to do the work for them.

Some TOGs developed strict water allocation procedures with a rotational water delivery system along the farm ditches. Farmers from these TOGs made large wooden signs outlining the TOG's allocation rules, and posted the signs along the main canal next to the turnout.

Farmers received water by different methods. Some received water directly from the main canal, while others received water from the farm turnout. Still other farmers pumped or siphoned water out of canals or natural ponds. Some farmers who badly needed water placed checks in the main canals at night to raise the water level at the turnouts.

By the end of August, some of the TOGs who rotated their water deliveries along the main or farm ditches abandoned this procedure. Sometimes it was because the TOG leader was not able to enforce the rules and regulations or because the farmers were accustomed to a more "laissez faire" system of water delivery. In other TOGs, the members were no longer interested in a fixed water delivery schedule because they wanted to finish transplanting as soon as possible. This usually caused some conflict in the rush to receive water. Other TOGs, however, continued their rotational water delivery and members cooperated with one another because the TOG leaders were respected.

In the beginning of the 1986 wet season, NESSI technicians worked with farmers to lay stakes to mark the proposed new turnouts and ditches. NESSI technicians would tell ICOs that they would be at a certain place at a certain time to lay out the stakes, and the ICOs would inform the farmers. Sometimes, however, the NESSI technicans arrived late, which frustrated the farmers and ICOs.

Despite misunderstandings, NESSI technicians said that Lam Chamuak farmers showed great willingness to participate in laying the stakes. The technicians compared the Lam Chamuak farmers favorably with farmers from other NESSI sites where farmers did not want to become involved.

ICOs had also organized TOGs at the extreme tail of the system, where farmers had never received Lam Chamuak water. Farmers at the tail also prepared stakes and waited for technicians to arrive. By

August 1986, however, NESSI realized that continued budgetary problems might prevent rehabilitating the system all the way to the extreme tail. This meant that these farmers would still not receive water from the Lam Chamuak tank. These farmers were originally told that water would reach them after the rehabilitation and improvement program. Now the extreme tail farmers began complaining, "My stakes are rotting while I wait!" The ICOs were particularly sensitive about this situation as they had originally helped these farmers organize TOGs in the expectation that water would arrive. The ICOs felt that the farmers would lose faith in their effort if water could not be delivered to these farmers.

Where rehabilitation and improvement will take place, there are formal, yet time-consuming, government procedures for considering farmers' suggested changes. According to government procedures, the NESSI field staff at Lam Chamuak cannot make any immediate change in the design based on farmers' suggestions. They first investigate if the farmer's request is technically feasible. There is no additional cost, and no other farmer is disturbed due to a change in design. After the site engineer's investigation, all cases for change are presented to the NESSI field project manager for consideration. If changes are to be made, the modifying design team from RID headquarters in Bangkok are asked to conduct a second investigation. This process takes much time.

At one farmer's field along the right main canal, NESSI technicians staked the position for a proposed change in the main ditch. The new main ditch will be on high ground, and farmers below the proposed ditch were afraid that seepage from the ditch would harm their fields. They talked to NESSI technicians, but the farmer who made this request was still waiting for an answer. Both farmers and NESSI officials are committed in principle to incorporating farmers' suggestions into the new design, and they are searching for a more efficient administrative mechanism to actually incorporate these suggestions.

Despite these problems, laying the stakes brought main system managers and farmers together through the TOGs. A dialogue in the field between farmers and NESSI/RID was begun.

During the summer, ICOs and RID officials also discussed the possibility of holding a TOG training session for the Lam Chamuak farmer leaders. Officials felt that such training would provide the farmers with a better understanding of the irrigation system and group work. Therefore, RID conducted a review and training session for TOG leaders from August 25-28, 1986. RID officials presented lectures on the background of the Lam Chamuak rehabilitation and improvement program, and on irrigation and water allocation. TOG leaders presented their organizational experiences over the past nine months. The ICOs then presented some suggested changes in design to RID officials on behalf of the farmers. NESSI and RID officials said they would seriously consider these suggestions.

END OF THE FIRST YEAR

By September 1986, the ICO workplan developed with Victoria Pineda was finished. Though RID wanted to keep the ICOs at Lam Chamuak as a team, arrangements had already been made to send the four, full-time RID ICOs back to their former positions, and one ICO left the program to take another job.

NESSI asked the remaining three female ICOs to become part of a "mobile team." NESSI officials were having trouble organizing farmers in the other NESSI sites. These officials hoped that by posting the remaining ICOs at the other sites for two-week assignments, they could help farmers organize viable irrigation groups.

During the fall of 1986, the mobile team travelled to the other NESSI sites to work with officials and farmers. The stays at each site, however, were very brief. By December, both NESSI and the ICOs concluded that two weeks was too short a time to begin an organizational process. At the end of two weeks, farmers were just beginning to understand who the ICOs were and what their role was. In addition, the ICOs stated that they preferred to be posted at Lam Chamuak because they had already started an organizational process and structure there and they were better acquainted with Lam Chamuak farmers.*

Throughout the latter part of 1986, documentation of the Lam Chamuak work continued. Dr. Kanda supervised the full-time social science research assistant at Lam Chamuak. This researcher interviewed sample farmers and key informants and kept a field diary of his observations. Dr. Kanda provided the minutes of the monthly site coordinating meetings and monthly reports of ICO and researchers' activities to RID and USAID/Thailand. Engineering and agronomic data were also systematically collected by the engineering field staff.

In December 1986, WMSII and RID sponsored a review and planning workshop for all Lam Chamuak participants. (See the WMS II publication, **Proceedings of the Review and Planning Workshop for the Thailand Irrigation Organization Project**, for a complete description of this workshop.) RID and NESSI officials, ICOs, Lam Chamuak farmer leaders, researchers, and WMSII personnel met for two weeks to review the 1986 work and plan for 1987. There was general agreement that the process should continue at Lam Chamuak, particularly as construction was scheduled to begin in the spring of 1987. All participants felt that involving farmers in the construction activities was important.

Despite the problems, RID officials were pleased with the first year's work and wished to extend the ICO effort to two nearby irrigation systems in need of rehabilitation and improvement. The ICOs wanted to continue their work, but said they needed to develop a new

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*Due to the delay in construction, the RID policy makers suggested that the ICOs should not return to Lam Chamuak until the contractor was redy to begin. The ICOs were asked to return to the project site in August 1987, just before construction began.

workplan for 1987. The farmer leaders attending the workshop praised the work of the ICOs and said they should return to Lam Chamuak.

On the final day of the workshop, senior Thai government officials and representatives from USAID/Thailand came to Lam Chamuak. After attending a briefing on the history and current status of the ICOs' work, all participants went to the field and met with a small group of farmers. At the conclusion of this one-day, senior officials' workshop, the Deputy Director General of RID stated that he was impressed with the Lam Chamuak effort, and he would make this a pilot project for RID.

CONCLUSIONS

Effective farmer involvement must contain both a process (participation) and a structure (farmer organizations). Both of these elements are present at Lam Chamuak, though in rudimentary form. Farmer participation and farmer organizations need to be improved. Within the TOGs, not all "free riders" have been controlled. At some locations in the system, farmers are still skeptical regarding the benefits of farmer organizations. Much work remains to be done.

Farmer participation activities in 1986 were only a part of the first of three "improvement" stages at Lam Chamuak: pre-construction, construction, and operations and maintenance. Though there were some disappointments and problems in the participatory approach at Lam Chamuak, the first phase was successful. In general, RID/NESSI, farmers, and ICOs are pleased with the results.

Participants, however, were frustrated that the approach was not been implemented more systematically after September 1986. At some locations in Lam Chamuak, wet season irrigation in 1986 was carried out more smoothly and equitably than in the past, due to the ICOs work with farmers and RID. At other locations, however, problems still remain.

There were some notable successes during 1986. Most importantly, the participatory process was started. Farmers told the project researchers that they like this approach as the ICOs did not try to become their "bosses." ICOs were able to act as catalyst agents or bridges between farmers and RID. Farmers often proved to be "ahead" of ICOs in their organizational work. ICOs admitted that this stimulated them to work even harder with the farmers.

Some effective TOGs were formed at Lam Chamuak. The TOGs established their own rules and regulations, and the rules were enforced by the farmers themselves. Some rules need to be improved, however.

The interaction between farmers and local RID personnel also improved. The NESSI site engineer said that Lam Cahmuak is easier to manage than other NESSI projects because of the organizational work. Even the district O&M officer (formerly called the water master) at Lam Chamuak said that in the past, the farmers at the tail of the system never greeted him when he came to the village, but now they do.

Some significant problems, however, also became apparent. There are a number of administrative and budgetary problems within the ICO program. Per diem, salaries, motorcycle repairs, and the like, were nagging problems to the ICOs that took along time to be resolved.

There are also more general problems with administering the program. The ICOs did not know if their participatory strategy would extend through the construction and O&M activities. They wanted to know if there is a future for them as ICOs within RID.

In addition, the ICOs' workplan needs adjustment and coordination with NESSI activities needs to be improved. Determining how fast or how slowly these organizational activities can be done is part of the learning process to develop a Thai farmer organizational strategy.

Another constraint was the minimal outside help that RID received to implement this project. They asked researchers to help them, but the research team tried to remain objective and neutral and avoided direct involvement with implementation. A few important USAID/Thailand personnel are keenly interested in Lam Chamuak, but budgetary restrictions and USAID's development strategy for Thailand preclude their involvement. WMSII provided some support for implementation (hiring NIACONSULT for the ICO training), but its financial and manpower support was not extensive. RID, new to the participatory process, had to rely on its own best judgment, with occasional help from university researchers and WMSII staff during short visits.

There does seem to be great potential for improved system performance at Lam Chamuak, particularly if farmers are actively involved in all stages of improvement. With some degree of continuity in the program, both farmers and RID officials can benefit from this participatory approach.

APPENDIX B
SAMPLE FARMER INTERVIEW SCHEDULE
(Translated to English from Thai)

Date: Time:

General Data

1. ID #:
2. Round:
3. Village:
4. Tambon:
5. Amphoc:
6. Ethnic group: ___ Thai Esan ___ Thai Korat
7. Age:
8. Education:
9. No. of H.H. members (# of children):
10. Labor under age 11:
11. Labor age (11-16):
12. Old age (60+ years):
13. No. of parcels of land within project site:
14. Location of farm:

First parcel

LMC	H	M	T
RMC	H	M	T
Farm ditch	H	M	T
Turnout No.:			
Length of farm ditch:			

Second parcel

LMC	H	M	T
RMC	H	M	T
Farm ditch	H	M	T
Turnout No.:			
Length of farm ditch:			

15. Size of farm ownership (including housing compound and farm:

Within the command area	____ rai	___ ngan
Outside the command area	____ rai	___ ngan
Total	____ rai	___ ngan

16. Size and land ownership status within the project area (there may be more than one answer):

Primary Status	Wet Season (rai/ngan)	Dry Season (rai/ngan)
Owner and cultivator		
Owner but rented out		
Owner but having relatives make use of some position without paying rent		
Owner but leaving some or all uncultivated		
Part owner		
Tenant		
Secondary Status		

17. In case of being the landlord, what is the agreement?

Agreement	Wet Season	Dry Season
Sharing system		
Rental rate		
Others (specify)		
NA		

18. In case of being the tenant:

To what extent are you confident in renting this parcel of land (%)?

0 25 50 75 100

Not at all (%)?

0 25 50 75 100

To what extent are you satisfied with rental rate (%)?

0 25 50 75 100

19. Cropping and yield data.

	Wet Season 1985						Dry Season 1986					
		Yields						Yields				
Crops/Varieties	Area of Crop (rai)	Measure	For Consumption	For Sale	Fertilizer	Pesticide	Area of Farm (rai)	Measure	For Consumption	For Sale	Fertilizer	Pesticide
<u>Rice</u>												
Leung-praw-tus												
Kao-pak-mo												
N sumpatong												
Kao-dok-mali												
RD												
<u>Upland Crops</u>												
Cassava												
Kenaf												
Rosehip												
Corn												
Mingbean												
Pineapple												
Others												
<u>Trees</u>												
Bamboo												
Eucalyptus												
Cotton												
Plums												
Lime												
Jackfruit												
Coconut												
Banana												
Other												
<u>Vegetables</u>												
Napa												
Cilantro												
Onion												
Garlic												
Green pepper												
Cucumber												
Tomatoes												
Watermelon												
Melon												
Others												

20. Data on irrigation water use:
From where did you get irrigation water?
Rain ___ Duck Pond ___
Lam C ___ Natural Pond ___

Sources of Water	Amount of Water Received									
	Wet Season 1985					Dry Season 1986				
	%	%	%	%	%	%	%	%	%	%
Lam Chamuak irrigation water										
Rain water										
Natural pond										
Dug pond										

21. When you need irrigation water, what did you do?
Request from President of WUA?
Request from TOG leader?
Request from RID official (name or position)?
Did nothing and waited until water is in the canal?
Other (specify)?

22. After the first day of water delivery, how long could you get water to your farm?

23. Did not know, but day wait until water was available in the main canal.

24. Water delivery system: which of the fall ?
Rotation among TOGs
Continuing system
Others (specify)

25. Was there any problem resulting from such water delivery systems?
___ Yes ___ No

If yes, what problem?

26. What criteria did you use in applying water to each crop?

Crop	Criteria: Soil Condition	Crop Growth	Time Schedule	From the Tank is Available	Others
Rice					
Sesame					
Groundnut					
Corn					
Vegetables					
Fruit trees (specify)					
Others (specify)					

27. What criteria did you use to stop irrigating?

Until rotational schedule ended?
Until water was accessible to all farms?
Until soil moisture was appropriate for crop?
Until crop standing was in good condition?
Others (specify)?

For more details:

28. How did you receive water?

Major Crop	Size of Crop	Step in Applying Water	No. Days	Reliability of Water					Water Adequacy					Source of Water				
				Never	Seldom	Sometimes	Often	Always	Never	Seldom	Sometimes	Often	Always	Irrigation System	Rain Water	Natural Pond	D./ Pond	Lam Chamuak Stream
Wet Season 1985																		
Rice																		
		Land prep.																
		Seed bidding																
		Transplant.																
		Planting																
		Early stage of crop growth																
		Flowering																
Other (specify)																		
Dry Season 1986																		
Sesame		Land prep.																
		Growth																
Bean		Land prep.																
		Growth																
Others (specify)																		
Mellon		Land prep.																
		Growth																
Vegetables		Land prep.																
		Growth																
Others (specify)																		

29. Did you hire labor in the wet season?

____ No ____ Yes

If yes, for what (stage)?

30. Wage rate (baht/per day)?

31. In case of receiving water from the Lam Chamuak Project:

Who decided when to deliver water to the main canals?

___ Irrigation Official
___ Zoneman
___ Don't know

How did the RID official deliver water to the main canal?

Who decided when to receive water from the farm ditch?

32. Among the TOG members, who is the first to obtain water?

___ Tailend farmer
___ Headend farmer
___ Everyone gets water at the same time
___ No definite schedule, depends on one's con??

33. [Question not translated.]

___ No, until water is adequate
___ Yes, by agreement

34. In case of stopping water delivery and you have not yet received water or received inadequate water or not, you can request for water?

	Wet	Dry
Never		
Seldom		
Sometimes		
Often		
Always		

35. In request water, whom did you approach?

___ President of WUA
___ RID official
___ TOG leader
___ Others (specify)

36. How did you get water to your farm?

___ directly from the farm ditch
___ by digging the farm ditch passing through others' farms
___ by water delivered from parcel to parcel

37. Who opens and closes the gate?

___ TOG leaders
___ RID officials
___ WUA members who need water
___ D.K.
___ Others (specify)

38. In the past 2-3 years, what problem(s) did you often hear about?

1.
2.
3.

39. (The interviewer read item by item.)

The problem between the headend and tailend of farm?
The problem between the headend and tailend of the main canals?
The problem between the rice farmers and the cassava farmers?
The problem between the influential and noninfluential farmers?
The problem between the farmes and the RID officials?
The problem of noncooperation among the farmers in irrigation maintenance activities?
Others (specify)?

40. Who solved the problem(s)?

41. How was the problem normally solved?

42. Cleaning the farm ditch and the main canals.

Activities	Frequency/ Year Wet	Frequency/ Year Dry	Participation Wet	Participation Dry	# of Day	Who Initiated	Punishment for Nonparticipation Members
The farm ditch							
1st time (month)							
2nd time (month)							
The main canal							
1st time (month)							
2nd time (month)							

Remarks:

43. Problems in the farmers' opinion.
In the past 2-3 years, what was the average yields?
Wet season (rice):
Dry season (crop...):

44. What is the most important problem in increasing crop production?

___ Credit
___ Soil
___ Water
___ Seed
___ Fertilizer
___ Pesticide
___ Market
___ Other (specify)

45. The first most important problem?

46. In your opinion, what would be the solution?

47. The second most important problem?

48. What would be the solution?

49. The third most important problem?

50. What would be the solution?

51. If the answer is "water," what aspect of a water problem?

___ Adequacy of water
___ The time need water
___ Irrigation maintenance
___ Other (specify)
___ Reliability of water
___ Conflict our water use
___ Defects of the design

52. Did you have problems in getting water to your farm?

___ Yes
___ No

53. If yes, what was the problem?
___ Water inaccessible to land?
___ Damp area
___ Other (specify)

54. Reason(s) for leaving land uncultivated (some portion or all)?
(more than 1 parcel of land)

___ Lack of capital
___ Water inaccessible to land
___ Salinity
___ Other (specify)
___ Lack of labor
___ Lack of water
___ Damp area
___ Employed elsewhere

55. In your opinion, to what extent is it necessary to organize the water users in terms of groups or WUAs for the following purposes?

Purposes	0% (not at all)	25%	50%	75%	100%
Cleaning the farm ditch					
Maintaining irrigation structure					
Water allocation at the farm level					
Linkage between RID officials and the farmers					

56. In your opinion, will WUA function better if it is combined with (part of) the Tambon council or other existing group?

___ Yes; reason:
___ No; reason:

57. If the WUA is to be divided into subgroups, which of the following is the best?

___ Left main canal group and right main canal group
___ Headend farmer group and tailend farmer group
___ Turnout groups as already exist
___ Other (specify)

Communication: Source of Information and Information Clarity

58. In the past 2-3 years, whom did you obtain the following information and how clear is the information?

	Source of Information				
Information	Govt. Official	Farmer	TOG Leader	President of WUA	Village Leader
Schedule for opening the tank water					
Schedule for closing the tank water					
Schedule of gate receiving water from the turnout					
Maintenance schedule					
Water supply					
Knowledge about water use at the farm level					
Knowledge about modern cropping (e.g. fertilizer)					
Crop planning					
Changes of the project					
Selection of President of WUA					
Selection of TOG leader					
Necessity for organizing water users					
Rehabilitation of the Lam Chamuak					

Clarity of Information:

___ Much ___ Medium ___ Little ___ No information obtained (not applicable)

Whether RID official gave you any information:

Information about:

Name or position of the RID official:

Farmers' Satisfaction

59. In the past 2-3 years, to what extent were you satisfied with the following matters?

	Satisfaction					
Items of the Matter	0%	25%	50%	75%	100%	Do Not Know
Construction of main canal						
Location of the turnout						
Water allocation at farm ditch level						
Cleaning main canal						
Cleaning farm ditch						
Water reliability						
Water adequacy						
Equity of water receipt						
Duration of water delivery						
Current water delivery system						
Agricultural Extension Services (e.g. cropping demonstrations, distributing fertilizers, pesticides)						
Receiving water						
Receiving water from same to but no fixed schedule; depending on who is convenient and when						
Convenience in getting water to farm and no rules on water use and no enforcement						
Solution to the water problem						
Cooperation of WUA members						
ICO approach/work						
RID official work						
Punctuality of RID official who called for the meeting						
Meeting schedule						
Places of meeting						
RID officials assistance requested by farmers						

60. In the past, what WUA activity(ies) are to your benefit?

61. In your opinion, how can you get more water users involved in operation and maintenance activities?

Willingness to Participate in the System Rehabilitation

62. To what extent are you willing to participate in rehabilitating?

63. Whom do you think should be responsible for such activities?

64. Willingness of Farmer Activities and Responsibilities:

Rehabilitating Activities	0%	25%	50%	75%	100%	Whose?
Farm Ditch Level						
Land devotion						
Labor devotion						
Searching for soil						
Transferring soil						
Soil compact						
Digging						
Searching for sand						
Concrete work						
Searching for grass						
Transferring grass						
Sodding						
Watering						
Main Ditch Level						
Land devotion						
Labor devotion						
Searching for soil						
Transferring soil						
Soil compact						
Digging						
Searching for sand						
Concrete work						
Searching for grass						
Transferring grass						
Sodding						
Watering						
Facilitating the System Rehabilitation						
Cooperate with RID official in identifying contour line						
Providing knowledge on topography						
Lending tools for construction and decoration						
Prepare his/her own food on the day scheduled for rehabilitating activities						

65. Farmers' expectation aft r the system rehabilitation:

How to solve such problems?

Concrete lining of earthen canal, sublateral and farm ditch?
Preventing seepage?
Installing the turnouts at appropriate location?
Raising the main canal level?
Constructing overpasses of the main canal?
Solving salinity?
Solving damp area (waterlogging)?
Improving feeder road
Others (specify)?

66. Do you think that other farmers would be willing to participate in the activities mentioned?

___ Not willing ___ Do not know ___ Willing ___

67. Last year, how did you earn your living?

Source of Income	Estimated Amount (฿)	Marketplace
Cropping		
Rice		
Sesame		
Fruits		
Vegetables		
Cassava		
Others		
Silkworm raising		
Sending money from outside		
Others		

68. Number of children or relatives who are not farmers? (Specify occupation)

69. If you have a choice, what occupation would you prefer your children and relatives to have?

___ Agriculture
___ Nonagriculture
Reason:

70. For more details:

APPENDIX C
KEY INFORMANT INTERVIEW SCHEDULE - FARMER

Date: Time:

1. Name of Interviewer: Title of Position:

2. Years experience in water use?

3. In the past, what do you think is the most important problem(s) you have that are obstacles in increasing crop production (please rank order)

___ Water	___ Size of Land	___ Credit
___ Soil quality	___ Market	___ Knowledge of agricultural innovation such as application of fertilizer
___ Other		

4. If water is the most important problem, what aspect of water problem? If the answer is not "water," ask whether or not water is the important problem.

The answer is water. The answer is "not water," but

Farmers' lack of knowledge about water use question.
Farmers' lack of rules and regulations regarding operation and maintenance.
Water supply was inadequate.
No water reliability.
Not all farmers received water.
Inequity of water allocation (between headend/tailend farmes).
Duration of water delivery is too short.
Others (specify)

5. What do you think would be the best way to solve such problem(s)?

6. In your opinion, is there any problem(s) or obstacle(s) in the main canal water control?

___ None ___ Yes, what?

7. What do you think would be the best way to solve such problem(s)?

8. In your opinion, is there any problem(s) or obstacle(s) in water control at the farm ditch level?

___ None ___ Yes, what is it?

9. In the past 2-3 years, how was maintenance, repairs, and cleaning made?

10. Water delivery: In the past few years, how was water allocated?

	Main Canal	Farm Ditch
When?		
How Often?		
Who initiated?		
Position?		
How?		
Characteristics of participants?		
Sex?		
Age?		
Land ownership status?		
Major crop?		
Mutual agreement?		
Punishment of non-participating members?		
Maintenance and repair?		

	Main Canal	Farm Ditch
Who set the schedule?		
What criteria was used?		
Who opened the gates?		
Who closed the gates?		
Water delivery system		
Water adequacy (compared to water demand)		
Reliability of water?		
Equity of water (e.g. between the headend and tailend farmers)?		
Is there any agreement on water receipt?		

11. In the past 2-3 years, which of the following problem(s) do you think you most frequently heard (please rank order)?

Problems	Frequency	Rank Order
Vegetable growing in the right-of way		
Problem b/w rice farmers and cassava farmers		
Let the cattle soak in the main canal		
Problem with headend farmers and tailend farmers		
Problem between the headend farmers of the farm ditch		
Problems between farmers and RID officials		

12. In your opinion, which farmer organization is successful? (both formal and nonformal)

Name of Farmer's Organization:
Major activities of the organization:

Factors contributing to the success of the organization:

13. In your opinion, to what extent is it necessary to organize TOG or WUA for the following purposes:

Activities	Necessity				
	0%	25%	50%	75%	100%
Cleaning farm ditch					
Digging the main ditches					
Digging the farm ditches					
Water allocation					
Repair of on-farm irrigation structure					

14. Do you think that WUA will function better if included in "Sapa Tambon," an existing local organization? Why?

___ No; reason:

___ Yes; reason:

15. In your opinion, will WUA function better if included subgroups of WUA?

___ No
___ Yes; Specify:

16. Is there any obstacles of WUA? How?

If yes, what factor(s) led to such problems?

17. What do you think would be the best way to solve the problem?

18. Are you aware of the government's need to get the farmers involved in rehabilitating projects?

___ No ___ Yes; from whom?

19. Do you think you can participate in the project?

Devote land?

Devote labor?

Lend construction tools?

20. After the project rehabilitating, what problem(s) do you expect to be solved? (Rank order)

Timing watercourse?
Appropriate turnout?
Raise the canal land?
Bridge?
Salinity?
Damp area?
Better feeder road?
Others (specify)

For more detail:

APPENDIX D
KEY INFORMANT INTERVIEW SCHEDULE - GOVERNMENT OFFICIAL

The Lam Chamuak Irrigated Agricultural Government Project
Nakon Ratchasima Province

Date: Time:

1. Name: Position Title:

2. How long at current assignment? ____ Years ____ Months

3. In your opinion, what is the water problem(s) of the project? (Please rank order)

4. What do you think would be the best way to solve such problems?

5. In the past, what was the most important farming problem(s) in increasing crop production in the command area? (Please rank order)

6. In your opinion, is there any problem(s) or obstacle(s) in the main canal water control?

   ___ None ___ Yes; what is it?

7. What do you think would be the best way to solve such problem(s)?

8. In your opinion, is the turnout installment along the main canal the obstacle in water control? Why?

   ___ Yes; because
   ___ No; because

9. In your opinion, is there any problem(s) or obstacle(s) in water control at the farm ditch level?

   ___ No
   ___ Yes; what is it?

10. What do you think would be the best way to solve such problem(s)?

11. In your opinion, what is the biggest problem with maintenance/cleaning of the irrigation system in the Lam Chamuak project area?

12. What do you think would be the best solution to the problem(s)?

13. What is the most frequent farmers' grievance?

14. What do you think would be the best solution to the grievance?

15. In your opinion, what is the major problem of the headend farmer?

16. What do you think would be the best solution to the problem?

17. In your opinion, what is the major problem of the tailend farmer?

18. What do you think would be the best solution to the problem?

19. What are the normal activities or procedures before water delivery?

    Meeting of farmers:

    Maintaining/cleaning/repairing irrigation system:
    - Main canal:
    - Farm ditch:
    - Farm data collection:
    - Request for water delivery:

20. What is the criterion for water delivery? (i.e. size of land planted, tank water supply, number of water users, etc.)

21. What is the system of water delivery?

    The reason for this system:

22. Which ways are used to make water delivery schedule available to farmers?
    - Openings?
    - Closures?

23. On the contrary, how is information communicated from the farmers to the officials? How long does it take the farmer's request to be decided?

24. How is the project normally maintained?

25. How are the farmers mobilized to maintain/clean the main canals?

26. Is there any punishment for nonparticipating members? How?

27. How are the farmers mobilized to maintain/clean/repair the farm ditches?

28. Is there any punishment for nonparticipating members? How?

29. Some farmers reported that they were not aware of delivery schedules, openings and closures; what do you think would be the reasons for that?

30. Some farmers reported that they were not aware of schedule for irrigation structure maintenance, main canals and farm ditches; what do you think would be the reason for that?

31. What action did/would you take if confronted with the following situations (interviewer slowly read item by item):

Situations	Reaction
After the closure, some farmers have not yet received water or received inadequate water.	
Some farmers let the cattle soak in the main canals.	
The farmers installed the illegal outlets.	
The farmers go fishing in the main canals.	
The farmers take the cracked concrete lined canal out to get some fishes.	
The farmers take unauthorized water (those outside the command area use siphon or pump to get water)	
The farmers grow vegetables in the right of way.	
The farmers practice cropping in the catchment area or in part of the the feeder road.	
If farmers on the same canal but different turnouts demand water at the same time.	
If the farm ditch water level goes down.	
The farmers raise water level in the farm ditch by building a check?	
If the headend farmers and the tailend farmers demand water at the same time.	

32. In the past, did you hear or were you aware of the following problems? Which problem(s) were most frequently heard? (Interviewer reads one item at a time)

Problems	Frequency: Do not know/ never	Seldom	Often
Problem between headend and tailend farmers on the main canal.			
Problem between headend and tailend farmers on the farm ditch.			
Problem between rice farmers and cassava farmers.			
Problem between influential and noninfluential farmers.			
Problem between Thai Korat and Thai Esan.			
Problem between tenants and landlords.			
Problem between neighboring farmers who do not let water pass through			
Others (specify)			

Details of each problem (e.g., who involved, how serious, how long, and solution).

33. In your opinion, which farmers' group in the command area is successful?

Name of group:
Major activity of that group:
Factor(s) for the group's success:

34. In your opinion, to what extent is there a need for organizing farmer water users in the form of group or association (in percentage)?

More details:

35. In your opinion, how can we get farmers' willingness to participate in rehabilitation of the project?

36. In your opinion, will the Water User Association function better if it is the same institution as Tambon Council or Sapa Tambon (community local administrative organization or other existing organization)? Why?

37. In your opinion, what was/were the problem(s) or obstacle(s) in WUA implementation? What would be the best solution(s)?

38. If there is a need to change the structure of WUA, what do you think would be the best one?

39. In performing your job, have you ever been faced with the following problem? And how?

Too much duty and responsibility?

Best solution?

To rigid official rules and regulations?

Best solution?

Motivation problem?

Best solution?

40. In your opinion, what would be the best way to improve the following matters?

RID official work performance?
Rehabilitation of the project to benefit the farmers?

Remarks:

APPENDIX E
RULES SET BY FARMERS TO REGULATE DITCH OPERATION AND MAINTENANCE

Table 1. Rules set by LMC farmers to regulate ditch operation and maintenance.

Rule		Fine	
		TOG 1	TOG 2
(1)	Members must participate in cleaning main canal or farm ditch when TOG calls for it.**	Ƀ 50/time or hire labor (1-2 times a yr)	Ƀ30/time, hire labor, or contribute food for participating members
(2)	Cannot break or damage irrigation structure or take fish.	Ƀ50/time	---
(3)	Cannot check canal or ditches.***	Ƀ50/time	---
(4)	Cannot put fishing nets in watercourse (obstructs the water).	Ƀ50/time	---
(5)	Cannot steal water.	Ƀ50/time	---
(6)	Cannot allow livestock to walk through canal.	Ƀ50/time	---
(7)	Farmers outside the command area are not allowed to damage irrigation structure or check watercourse.****		
(8)	Cannot damage feeder road with any vehicle or drive any vehicle in the canal intentionally.	---	---
(9)	Must be present at TOG meeting.	---	---

*Ƀ = baht
**This rule was enforced frequently, but not always.
***Farmers sometimes obey this rule; most farmers now know checking is prohibited.
****Difficult to enforce. Go to village headman first.

	Fine		
	TOG 3,4	TOG 5	TOG 6,7
(1)	---	Contribute food for participating members.	฿30/timo or hire labor (once a month)
(2)	---	---	---
(3)	฿100/time	---	---
(4)	One warning, then ฿100/time	---	---
(5)	One warning, then punishment.	---	฿50/time
(6)	/100/animal/time	---	One warning, then ฿25/animal/time
(7)	Report incident to offender's, headman; if he still does it, ฿500.	---	---
(8)	---	---	---
(9)	---	---	---

	Fine			
	TOG 8	TOG 9	TOG 10	TOG 11
(1)	No punishment	No punishment	No punishment	Hire labor.
(2)	One warning, then B500/time B500/time	---	One warning, then B50-500/ time	B500/person/ time
(3)	---	---	---	---
(4)	One warning, then B50/time	One warning, then B50-500/ time	B50-500/time	For large net, B100/time;
(5)	B50/time	B50/time	---	B50/time
(6)	One warning, then B50/ animal/time	One warning, then B50/ animal/time	B50/animal/ time	B50/animal/ time
(7)	---	---	---	---
(8)	B100/vehicle/ time	The TOG considers punishment.	---	---
(9)	---	B50/time	---	---

	Fine			
	TOG 12	TOG 13	TOG 14	TOG 15
(1)	Ƀ50/time or hire labor	Ƀ30/time	Ƀ60/time or hire labor	---
(2)	Ƀ100/time	Ƀ100/person/time	Ƀ100/time	---
(3)	---	---	Ƀ100/time	---
(4)	Ƀ100/time	Ƀ100/person/	Ƀ100/time	---
(5)	First let both sides discuss. If rule still broken, Ƀ100/time	---		---
(6)	One warning, then Ƀ50/ animal time	One warning, then Ƀ50/animal/time		---
(7)	---	---	---	---
(8)	---	---	---	---
(9)	---	---	---	---

Fine				
	TOG 16	TOG 17, 18	TOG 19, 20	TOG 21,22
(1)	---	---	---	---
(2)	---	B500/person/time	---	---
(3)	---	B500/person/time	---	---
(4)	---	B500/person/time	---	---
(5)	---	---	---	---
(6)	---	---	---	---
(7)	---	---	---	---
(8)	---	B500/time	---	---
(9)	---	---	---	---

Fine				
	TOG 23	TOG 24	TOG 25, 26	TOG 27
(1)	฿30/time	฿30/time/person or hire labor.	฿50/time or hire labor.	฿30/time or hire labor if informed; if uninformed, ฿60/time
(2)	---	---	฿300/time	฿500
(3)	฿50/time/ person	฿500/time	฿300/time	฿500
(4)	฿100/time/ person	฿500/time	฿300/time	฿500
(5)	---	฿50/time	฿300/time	฿500
(6)	One warning, then ฿50/ animal time	฿100/animal/ time	---	---
(7)	---	---	---	---
(8)	---	---	---	---
(9)	---	---	฿30/time	---

Table 2. Rules set by RMC farmers to regulate ditch operation and maintenance.

Rules	Fine	
	TOG 1	TOG 2
(1) Members must participate in cleaning canal or farm ditch.	B30/time	B50/time
(2) Cannot break or damage irrigation structure.	B50/time Member fined B100/time	B300/time
(3) Cannot check watercourse or pollute canal.	B100/time	B200/time
(4) Cannot put fishing nets in watercourse.	B100/time	B50/time
(5) Cannot steal water.	Stop delivering water	B50/time
(6) Cannot allow livestock to walk through canal.	B100/animal	---
(7) Must be present at meeting.	B30/time	Stop delivering water to those who are absent twice
(8) Cannot grow vegetables on the canal embankment.*	---	---

*This rule has been effective: vegetable gardening on canal banks has stopped.

	Fine		
	TOG 3	TOG 4	TCG 5, 6**
(1)	฿50/time	฿30/time	฿30/time
(2)	---	฿500/time	---
(3)	฿100/time	---	One warning, then ฿50/time
(4)	฿100/time	฿100/time	One warning, then ฿50/time
(5)	Both sides agree upon	[illegible]/time	One warning, then ฿50/time
(6)	---	฿100/[illegible]ne	---
(7)	---	---	Stop delivering water to those absent 3 times
(8)	---	---	---

**Met at same time.

	Fine			
	TOG 7, 8**	TOG 9, 10**	TOG 11, 12**	TOG 13
(1)	₿25/time in wet season	₿30/time	₿25/time	Had no TOG meeting. Each member had some work to be done, and each member is scattered far away. The leader has been unable to communicate with TOG members about scheduling a meeting.
(2)	---	---	---	
(3)	---	---	---	
(4)	₿500/time	₿100/time	₿200/time	
(5)	One warning, then ₿50/time	---	---	
(6)	₿50/animal/time	₿50/animal	Warn and prohibit.	
(7)	Three warnings, then ₿50	---	₿50/time	
(8)	Absolutely prohibited in 1986.	Absolutely prohibited.	Warn and prohibit.	

**Met at same time.

	Fine		
TOG 14,15,16,17,18**	TOG 19	TOG 20	TOG 21, Group 1
(1) ฿30/day	฿30/day	Same as wage rate for particular year	฿60/time (in April)
(2) ---	---	---	---
(3) Not to exceed ฿200	Not to exceed ฿200	฿200/time	---
(4) Two warnings, then ฿200	Two warnings, then ฿200	One warning, then ฿100	---
(5) Not to exceed ฿200	Not to exceed ฿200	---	฿500/time
(6) ฿100/animal	Warning	฿200/time	---
(7) ---	---	---	---
(8) ---	Have RID officials enforce irrigation law/fine	฿500	---

**Met at same time.

Fine		
TOG 22	TOG 23, 24**	Tail-End Farmers (km 9+100-13+000)
(1) ฿30/day	฿60/day	These farmers' land is inaccessible to water and they have never received Lam Chamuak water. No rules have been developed. Each group contacted reported that they were interested in doing the following tc receive water as part of the rehabilitation effort. Group 1: Devote labor and land. Group 4: Will obey any rules made. Group 2,3: Devote labor and land for main ditch construction, or even money if they can afford to do so. Group 5: Establish water user groups and develop rules. Group 6,7: Do not want irrigation canal because of waterlogging. Group 8: Devote labor and cooperate as requested.
(2) ฿100/day	---	
(3) ---	---	
(4) ฿ 100/day	---	
(5) ---	---	
(6) Two warnings, then ฿50/ animal	฿25/animal	
(7) ---	---	
(8) ---	---	

**Met at same time.

APPENDIX F

UNAUTHORIZED TURNOUTS ON THE RMC IDENTIFIED BY THE RESEARCH ASSISTANT

Located Between	Side of Canal	Diameter (cm)
TOG2 and TOG3	right	20
TOG5 and TOG6	left	10
TOG9 and TOG10	right	20
TOG12 and TOG13	left	20
TOG17 and TOG18	left	20

APPENDIX G
LIST OF RECOMMENDED RICE VARIETIES IN THAILAND (1984)

No.	Variety Name	Type	Harvesting (day)	Reaction to diseases						Reaction to insects				Year of Release
				BL	BS	Sh.B	BB	YOLV	RSV	BPH	GLH	SB	GM	
	Non-Photosensitive Var.													
1	RD1	NG	130	S	MS	S	S	S	S	S	S	S	S	1969
2	RD2	NG	130	S	MS	S	S	MS	S	S	R	S	S	1969
3	RD3	NG	128	S	MS	-	S	S	S	S	S	S	S	1969
4	RD4	G	127	S	S	MS	S	S	S	R	R	S	R	1973
5	RD5	NG	140	S	MS	-	MR	S	S	S	S	S	S	1973
6	RD7	NG	120-130	MR	MR	-	R	S	MS	S	R	S	S	1973
7	RD9	NG	115-125	S	S	MS	VS	MS	MS	R	R	MS	R	1975
8	RD10	G	130	MR	-	-	S	S	S	S	S	S	S	1981
9	RD11	NG	135	MR	MS	R	S	S	S	S	S	S	S	1977
10	RD21	NG	120-130	S	S	S	MR	S	MR	R	MR	S	S	1981
11	RD23	NG	120-130	S	MS	MS	R	S	MR	R	MR	S	S	1981
12	RD25	NG	100	S	S	S	MR	S	MR	R	MR	S	S	1981
	Northern Region													
1	Muey Nawng 62M	G	Nov.20	S	MR	-	S	S	S	S	S	S	R	1959
2	RD6	G	Nov.21	MR	MR	-	S	S	MS	S	R	S	S	1977
3	Khao Dawk Mali 105	NG	Nov.25	S	MS	MR	MS	S	S	S	S	S	S	1959
4	Leuang Yai 148	NG	Nov.25	S	MS	-	MS	S	S	S	S	S	S	1968
5	Niaw San-pah-tawng	G	Nov.26	MS	MR	-	MS	S	MS	S	S	S	S	1962
	North-Eastern Region													
1	Hahng Yi 71	G	Nov.4	R	MS	-	S	S	MS	S	MS	S	S	1968
2	Nam Sa-gui 19	NG	Nov.4	MS	MS	-	S	S	S	S	MS	S	S	1968
3	RD15	NG	Nov.10	S	MR	MR	S	S	S	S	S	S	S	1978
4	Khao Dawk Mali 105	NG	Nov.20	S	MS	MR	MS	S	S	S	S	-	S	1959
5	RD6	G	Nov.21	MR	MR	-	S	S	MS	S	R	S	S	1977
6	RD8	G	Nov.23	MS	MR	-	MS	S	-	S	MS	S	S	1978
7	Niaw San-pah-tawng	G	Nov.26	MS	MR	-	MS	S	MS	S	S	S	S	1962
8	Khao Pahk Maw 148	NG	Dec.3	MS	MS	-	MS	S	S	S	S	S	S	1965
9	Khao Tah Haeng 17	NG	Dec.20	-	-	MS	S	-	MS	-	-	-	-	1979
10	Niaw Ubon 1	G	Nov.15	-	-	-	S	S	S	MS	S	VS	-	1984

No.	Variety Name	Type	Harvesting (day)	Reaction to diseases						Reaction to insects				Year of Release
				BL	BS	Sh.B	BB	YOLV	RSV	BPH	GLH	SB	GM	
	Central Region													
1	Gow Ruang 88	NG	Nov.21	S	MS	-	MS	S	S	S	MR	S	S	1962
2	Nahng Mon S-4	NG	Nov.26	MS	MS	-	MS	S	S	S	S	S	S	1956
3	Khao Pahk Maw 148	NG	Dec. 3	MS	MS	-	MS	S	S	S	S	S	S	1965
4	Leuang Pra-tew 123	NG	Dec.19	S	MS	-	S	MS	MR	S	S	S	S	1965
5	Khao Tah Haeng 17	NG	Dec.20	-	-	MS	S	S	MS	S	S	S	S	1956
6	RD27	NG	Dec.10	S	-	-	S	S	MR	S	MS	-	-	1981
	Southern Region													
1	Puang Rai 2	NG	Feb. 6	S	MS	-	S	S	S	S	MR	S	S	1968
2	Nahng Pa-yah 132	NG	Feb.16	S	MR	-	MS	S	S	S	MR	S	S	1962
3	Peuak Nam 43	NG	Feb.22	S	MR	-	MS	S	S	S	MS	S	S	1968
4	RD13	NG	Feb.26	R	MR	MR	S	S	S	S	MS	S	S	1978
5	Gaen Jan	NG	late Feb.	S	-	-	-	MR	R	S	MR	-	-	1983
	Floating Rice													
1	Nahng Cha-lawng	G	Nov.30	MR	MS	-	S	S	S	S	S	S	S	1969
2	Ta-pow Gaew 161	NG	Dec. 9	S	MS	-	S	S	S	S	S	S	S	1959
3	Leb Meu Nahng 111	NG	Dec.19	MS	MR	-	MS	S	S	S	S	S	S	1959
4	Pin Gaew 56	NG	Dec.29	S	MS	-	MS	S	S	S	MS	S	S	1959
5	RD19	NG	Dec.15	S	-	S	MS	S	S	S	S	S	S	1979
6	RD17	NG	140 days	MR	S	-	MS	S	MS	S	S	S	S	1979
	Upland Rice													
1	Sew Mae Jan	G	Oct.15	MS	MS	-	S	-	-	S	S	S	S	1979
2	Dawk Pa-yawm	NG	150 days	-	-	-	S	-	-	S	S	S	S	1979
3	Goo Meuang Luang	NG	Dec.15	MR	-	VS	S	VS	S	S	S	S	S	1979

G = Glutinous
NG = Non Glutinous
BL = Blast BS = Brown Spot Sh.B = Sheath Blight
BB = Bacterial Leaf Blight YOLV = Yellow Orange Leaf Virus
RSV = Ragged Stunt Virus SB = Stem Borer
BPH = Brown Plant Hopper

Source: Rice Research Institute, Department of Agriculture, Bangkok, Thailand.

APPENDIX H

LIST OF WATER MANAGEMENT SYNTHESIS II PROJECT REPORTS

WMS 1 Irrigation Projects Document Review

Executive Summary
Appendix A: The Indian Subcontinent
Appendix B: East Asia
Appendix C: Near East and Africa
Appendix D: Central and South America

WMS 2 Nepal/USAID: Irrigation Development Options and Investment Strategies for the 1980s

WMS 3 Bangladesh/USAID: Irrigation Development Options and Investment Strategies for the 1980s

WMS 4 Pakistan/USAID: Irrigation Development Options and Investment Strategies for the 1980s

WMS 5 Thailand/USAID: Irrigation Development Options and Investment Strategies for the 1980s

WMS 6 India/USAID: Irrigation Development Options and Investment Strategies for the 1980s

WMS 7 General Asian Overview

WMS 8 Command Area Development Authorities for Improved Water Management

WMS 9 Senegal/USAID: Project Review for Bakel Small Irrigated Perimeters Project No. 685-0208.

WMS 10 Sri Lanka/USAID: Evaluation Review of the Water Management Project No. 383-0057.

WMS 11 Sri Lanka/USAID: Irrigation Development Options and Investment Strategies for the 1980s

WMS 12 Ecuador/USAID: Irrigation Sector Review

WMS 13 Maintenance Plan for the Lam Nam Oon Irrigation System in Northeast Thailand

WMS 14 Peru/USAID: Irrigation Development Options and Investment Strategies for the 1980s

WMS 15 Diagnostic Analysis of Five Deep Tubewell Irrigation Systems in Joydebpur, Bangladesh

WMS 16 System H of the Mahaweli Development Project, Sri Lanka: 1982 Diagnostic Analysis

WMS 17 Diagnostic Analysis of Farm Irrigation Systems on the Gambhiri Irrigation Project, Rajasthan, India: Volumes I-V

WMS 18 Diagnostic Analysis of Farm Irrigation in the Mahi-Kadana Irrigation Project, Gujarat, India

WMS 19 The Rajangana Irrigation Scheme, Sri Lanka: 1982 Diagnostic Analysis

WMS 20 System H of the Mahaweli Development Project, Sri Lanka: 1983 Diagnostic Analysis

WMS 21 Haiti/USAID: Evaluation of the Irrigation Component of the Integrated Agricultural Development Project No. 521-0078.

WMS 22 Synthesis of Lessons Learned for Rapid Appraisal of Irrigation Strategies

WMS 23 Tanzania/USAID: Rapid Mini Appraisal of Irrigation Development Options and Investment Strategies

WMS 24 Tanzania/USAID: Assessment of Rift Valley Pilot Rice Project and Recommendations for Follow-On Activities

WMS 25 Interdisciplinary Diagnostic Analysis of and Workplan for the Dahod Tank Irrigation Project, Madhya Pradesh, India

WMS 26 Prospects for Small-Scale Irrigation Development in the Sahel

WMS 27 Improving Policies and Programs for the Development of Small-Scale Irrigation Systems

WMS 28 Selected Alternatives for Irrigated Agricultural Development in Azua Valley, Dominican Republic

WMS 29 Evaluation of Project No. 519-0184, USAID/El Salvador, Office of Small-Scale Irrigation -- Small Farm Irrigation Systems Project

WMS 30 Review of Irrigation Facilities, Operation and Maintenance for Jordan Valley Authority

WMS 31 Training Consultancy Report: Irrigation Management and Training Program

WMS 32 Small-Scale Development: Indonesia/USAID

WMS 33 Irrigation Systems Management Project Design Report: Sri Lanka

WMS 34 Community Participation and Local Organization for Small-Scale Irrigation

WMS 35 Irrigation Sector Strategy Review: USAID/India; with Appendices, Volumes I and II (3 volumes)

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