

## Water Management Practice in Upper Chao Phraya Delta, Thailand

— Analysis of water use in the Borommathad Irrigation Project —

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-Analysis of water use in the Borommathad Irrigation Project-

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### Abstract

This paper focuses on clarifying the present water management practice at the on-farm level in the upper Chao Phraya Delta based on detailed field surveys, and discusses the problems of water management including the development of farmers' water management organizations. The Thai government has implemented a target area policy to give farmers equal opportunities to access water during the dry season and created systematic water management plans including farmers' participation in water management. The target area policy is not fully successful because of the difficulty in controlling farmers' intakes. According to the field surveys, upstream farmers have an advantage of taking water from both lateral irrigation canals and irrigation ditches. In the upstream area of the lateral canal, rice planting was finished in about 40 days, the shortest duration of the survey areas. Downstream of the irrigation ditch, due to insufficient water, farmers reuse drainage water by either pumping up from a lateral drainage canal or by checking a field drain. This reveals that the thorough reuse of drainage water contributes to increasing the area of the dry-season rice cropping. Variations in both the timing and the water sources for rice planting make the farmers difficult to cooperate within the beneficiary area of an irrigation ditch, thus the farmers' water management organizations are not functioning effectively.

*Keywords : water management, farmers' organization, RID, reuse of drainage water*

### 1. INTRODUCTION

The Chao Phraya Delta had attracted people's attention as a possible food supply area in the midst of a worldwide food shortage after World War II. The World Bank decided to finance a large scale irrigation project in the Chao Phraya Delta and modern irrigation facilities, such as the Chai Nat Diversion Dam, canal networks, Bumipol Dam and Sirikit Dam, which were constructed by 1972 (Ishii, 1978). The completion of these facilities and the water management system has consequently brought the stability in wet-season rice cropping and even the development of dry-season rice cropping. However, there is a strict limit on available water resources for dry-season rice cropping (Kasetsart University and ORSTOM, 1996).

As irrigation facilities were developed, the improvement of water management systems was needed. In 1963, the Royal Irrigation Department (RID) launched a water management system plan based on the idea of enhancing farmers' participation in water management. Under this plan, RID was responsible for water distribution and facilities maintenance on the main and lateral canals, and organizations consisting of beneficiary farmers were expected to perform water management at the on-farm level. However, it is said that the development of the farmers' water management organizations hasn't been very successful (JICA, 1990).

The purpose of this paper is to clarify the present water management practice at the on-farm level based on detailed field surveys in the upper Chao Phraya delta and to discuss the problems of water management including the development of farmers' water management organizations.

### 2. WATER MANAGEMENT PROBLEMS IN THE UPPER CHAO PHRAYA DELTA

#### 2.1 Limited water resources for dry-season rice cropping

##### 2.1.1 Change of rice cropping area

The implementation of the Greater Chao Phraya Project led to the stability of wet-season rice cropping and the development of dry-season rice cropping. Fig.1 indicates the yearly change in the rice cropping area in the Delta. It shows that the rice cropping area in the dry season changes from year to year and is mostly less than half of that of the wet season. This implies that irrigating the whole delta area is not possible with only the remaining water in the Bumipol and Sirikit reservoirs at the end of the wet season and, consequently, some rules are needed for allocating the limited water resources among the beneficiary farmers.

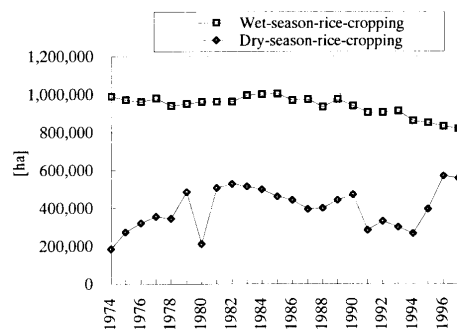


Fig.1 Yearly change in rice cropping area in the Chao Phraya Delta.  
Source: RID

### 2.1.2 Target area policy

The RID decides on the area to be irrigated for the dry-season rice cropping based on the remaining water in the Bumibol and Sirikit reservoirs at the end of the wet season. This is called target area policy. The target area is assigned to a place where rice wasn't planted or an area which suffered from disaster during the wet season, and where rice wasn't planted during the previous dry season or where land consolidation was implemented (Nakajima, 1992).

### 2.2 Water management organizations

RID, under the Ministry of Agriculture and Cooperatives, is responsible for water management in Thailand. The country is divided into 12 regions and an Irrigation Regional Office (IRO) is established in every region. IRO 7, 8 and part of 9 cover the Chao Phraya Delta, and they control 25 Irrigation Projects constructed in the 1960's. Irrigation Project Offices carry out water allocation, operation, and maintenance of irrigation facilities on main and lateral canals in their command areas.

At the on-farm level, the farmers' water management organization is responsible for water management. In 1963, the RID established the first farmers' water management organizations, the Water Users' Associations (WUAs). The WUA covers the beneficiary area of a lateral canal. It aims at allocating water, maintaining irrigation facilities, arbitrating water conflicts, selling agricultural chemicals, fertilizer and equipments to farmers. However the WUA didn't function successfully because the command area was too large (JICA, 1990). In 1979, the RID decided to start Water Users' Groups (WUGs). The WUG covers the beneficiary area of an irrigation ditch. It aims at allocating water and maintaining irrigation facilities. Uniting some neighboring WUGs, Integrated Water Users' Groups (IWUGs) were established in 1989. IWUG covers the same area as WUA. However, most of organizations are not functioning successfully (JICA, 1990).

## 3. WATER MANAGEMENT IN THE BOROMMATHAD IRRIGATION PROJECT

### 3.1 Outline

The Borommathad Irrigation Project, which is one of 25 Irrigation Projects in the Delta, was completed in 1964, covering 58,400 hectares of agricultural land. It is located in the upper Delta, as shown in Fig.2 and under the supervision of IRO 7. As shown in Fig.3, three main canals, 1R, 1L and 2L, get water independently from the reservoir of the Chai Nat Diversion Dam. The 1R main canal is in the right bank, and the 1L and 2L main canals are in the left bank of the Noi river. This project was divided into 4 sections and 42 zones. Sections 1, 2, 3 and 4 are located in the beneficiary area of 2L, 1L, upstream of 1R and downstream of 1R, respectively and each zone is located in a beneficiary area of a lateral canal. The area of a section and a zone is about 10,000 hectares and several thousand hectares, respectively.

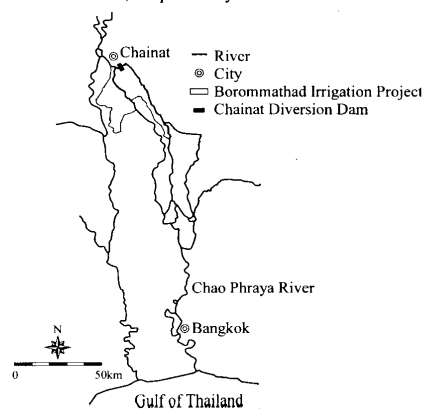


Fig.2 Location of Borommathad Irrigation Project.

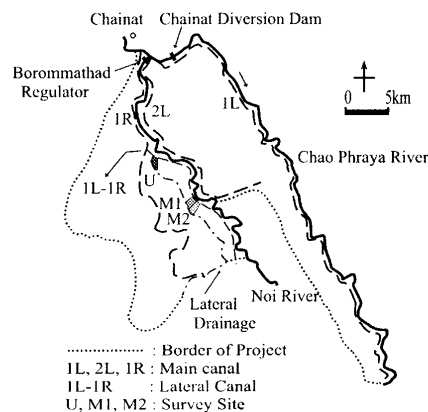


Fig.3 Layout of main facilities in the Borommathad Irrigation Project.

### 3.2 Water distribution

#### 3.2.1 Water distribution system

This project office has a water management unit that consists of a project engineer, 4 water masters, 26 zone men and 250 gate tenders (1997). The project engineer has the responsibility for everything in the project and judges on various problems occurring there. A water master supervises each section. He adjusts water distribution to some lateral canals from the main canal within his section based on reports from zone men on the state of water distribution. Zone men supervise each zone. He adjusts water distribution to some irrigation ditches from the lateral canal within his zone and observes the state of maintaining irrigation facilities on the main and lateral canals and planting crops, and furthermore, he reports the results of these to the water master. The gate tender operates intake gates and check gates in the canals following the instructions of a water master or zone man, and cleans the gates.

#### 3.2.2 Water distribution practice

Planting for dry-season rice starts between February and March and ends with harvesting from May to June, when the wet season starts. Water release for dry-season rice cropping from the Bumipol and Sirikit reservoirs begins in February.

In this project, irrigation water for dry-season rice cropping is alternately distributed to the right bank area and to the left bank area of the Noi River every year, to achieve equity among the farmers. In 1997, a plan to allocate water for domestic and upland crops to the left bank area and water for domestic, upland crops and irrigation to the right bank area of the Noi River was made before the dry-season rice cropping started.

Actual water distribution to the main canals is performed based on decisions made at weekly meetings in IRO 7, while, distribution from the main to the lateral irrigation canals is done empirically, not based on calculation. Officers in charge of water management can judge, by looking at the water levels in the lateral irrigation canals, whether the water is sufficient or not. They also get supplemental information from surveying the canals and by farmers' claims to readjust the water distribution.

In the 1L-1R lateral canal, most of intake gates for irrigation ditches have been broken and thrown away by farmers who couldn't get enough water in cases of insufficient supply. Even if a zone man repairs the intake gates, they are broken again. Consequently, he can't adjust the water distribution to each ditch by operating its intake gate.

### 3.3 Target area

In 1997, the Borommathad irrigation project was allocated approximately 17,000 hectares of the target area, which was less than one third of the command area. The beneficiary area of the 1R canal, 30,400 hectares, had its turn for the target area in 1997.

Fig.4 shows both the planned target area and the actual rice planted area in the dry season of 1997. The planned target area was situated around the main and lateral irrigation canals and it didn't extend to the downstream area of the lateral irrigation canals or irrigation ditches. On

the other hand, the actual rice planted area reached 37,000 hectares, which was more than two times as large as the target area. The planted area extended even to some parts of the left bank, most of which were located in upstream or riparian areas. There are some reasons for that. Firstly, farmers used the irrigation water for domestic and upland crop purposes. Secondly, they also used drainage water and well. Thirdly, actual distributed water to 1L and 2L canals was more than planned.

Next, we clarify the detailed water distribution at the plot level.

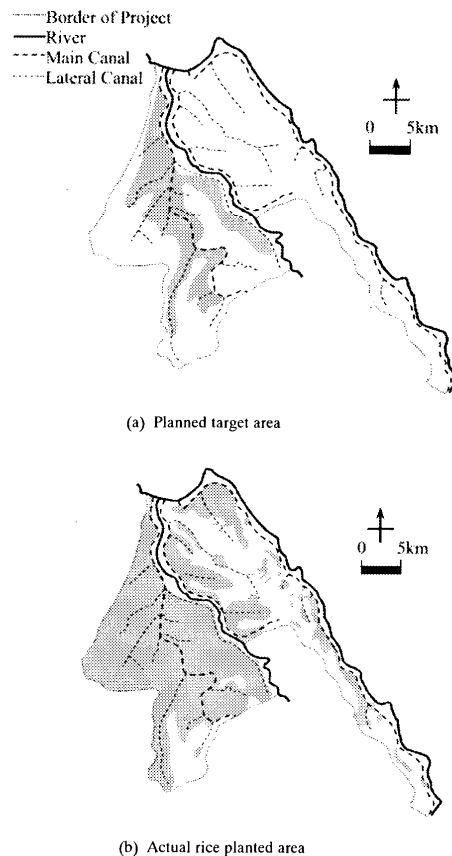


Fig.4 Planned target area and actual rice planted area in the dry season of 1997 in the Borommathad Irrigation Project.

Source: Borommathad Irrigation Project

## 4. ON-FARM WATER MANAGEMENT PRACTICE

### 4.1 Purpose of field survey

The purpose of the field survey is to clarify the present water management practice at the on-farm level. For this purpose, the authors measured flow rate at the intake of every irrigation ditch, observed water

distribution and the progress of rice planting at the plot level. The survey was performed during the preparation season for the dry-season rice cropping, February to March in 1997.

#### 4.2 Outline of the survey area

Three survey areas, U, M1 and M2, were selected. Every area is within the beneficiary area of several irrigation ditches. The number of irrigation ditches in U, M1 and M2 is 3, 3 and 2, respectively. The area of the survey sites is shown in Table 1. The location of the survey site is shown in Fig.3. U is at the upper reaches of, and M1 and M2 are at the middle reaches of the 1L-1R lateral irrigation canal. U, M1 and M2 are at 1.2km, 10.0km and 10.5km down the intake of 1L-1R canal, respectively (Fig.3).

Since land consolidation was implemented at the beginning of 1980's at every survey area, irrigation ditches, field drains and farm roads connect to most of the plots at which land leveling is done.

Table 1 The area of the survey sites

	[ha]		
Survey site	U	M1	M2
Total area	142.9	149.8	136.7
Farmland	130.6	148.1	133.1

#### 4.3 Water distribution during the preparation season for the dry-season rice cropping

##### 4.3.1 Measurement of the flow rate

Each survey area receives and drains water through several irrigation ditches and field drains, respectively. Flow rates at the intakes of irrigation ditches and the outlets of field drains are measured three times from the middle of February to March. Table 2 shows the results of average flow rates at the intake of the irrigation ditches and the average intake rate in depth. It indicates that U, an upstream area, could get more water than M1 and M2, which are middle reach areas. The intake gates of all irrigation ditches have been broken and thrown away in these survey areas. Every field drain outlet at U was closed and no water drained to the lateral drainage canal from the middle of February to March.

Table 2 Average flow rates at the intake of the irrigation ditches and the average intake rate in depth at each survey area

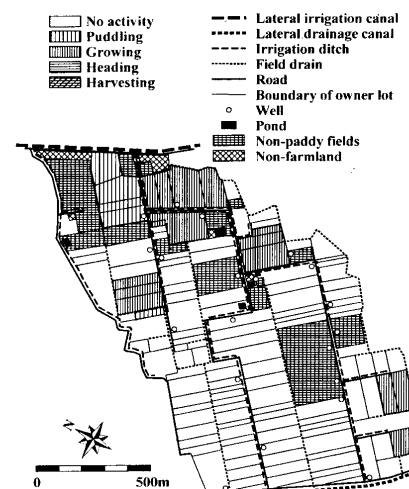
Survey site		U	M1	M2
Average flow rates	[m <sup>3</sup> /s]	0.152	0.092	0.086
Average intake rate in depth	[mm/d]	12.0	6.7	5.9

##### 4.3.2 Progress of the preparation works

During the survey the authors investigated the state of every plot in each survey area 5 times, classifying them into 5 categories; no activity, puddling, growing, heading and harvesting. Puddling was performed with two wheel or four wheels tractors, and the field was planted with broadcasting.

Fig.5 are part of the survey results for M1 on January 31, February 21 and March 18, respectively.

Water release from the Bumipol and Sirikit Dams for the dry-season rice cropping began on February 1. The water reached the irrigation ditches in the survey areas 4



(a) January 31, 1997



(b) February 21, 1997



(c) March 18, 1997

Fig.5 Change of the preparation works for dry-season rice cropping in M1.

days later.

Fig.5(a) shows the state of the plot just before the irrigation of dry-season rice cropping. We know, by Fig.5(a), that some plots, 16 hectares, had already finished planting rice before the released water reached the area. This indicates that almost 11% of the farmland had been planted with rice. This ratio was 6% and 10% in U and M2, respectively. It should be noted that several plots in most downstream areas finished preparation prior to the plots in the middle. Fig.5(b) and (c) show that the preparation works generally proceeded from the upper plots to the lower plots after water reached the irrigation ditches.

Fig.6 shows the progress of the area planted with rice in U, M1 and M2. To finish planting rice, U took about 40 days, the shortest of these survey areas. Taking more water as shown in Table 2, rice planting was finished within shorter duration in upper reaches than in middle reaches.

Concerning this water distribution process, the authors couldn't recognize any kind of cooperation and coordination among farmers as organization. The farmers took water individually or cooperated with some downstream farmers concerned with pumping from the lateral drainage canal.

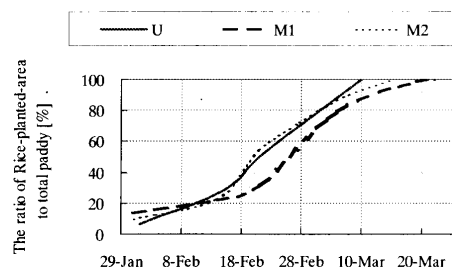


Fig.6 Progress of the area planted with rice in U, M1 and M2.

#### 4.3.3 Water sources for irrigation

Fig.7 presents the spatial distribution of water sources for irrigation during the preparation season for dry-season rice cropping in M1. The water sources are classified into 3 categories in the survey: irrigation canal, drainage canal and both.

As Fig.7 indicates, the upper reach plots took water mostly from lateral irrigation canals or irrigation ditches. Some upstream plots, which had finished planting rice before the irrigation water for the dry-season rice cropping reached the area, that is, before February 4, took water from a lateral canal using private pumps. While, lower area plots took water from a lateral drainage canal by pumping or from field drains by checking, and besides, there are plenty of plots taking water from both the irrigation and drainage canals. They use drainage water in addition to insufficient irrigation water.

The ratios of the areas by water source categories are presented in Table 3. The total ratio of drainage canals and both irrigation and drainage canals in the lower survey areas, M1 and M2, are higher than those in the upper survey area, U.

In the survey areas, all of the plots were eventually planted. Every plot had some kind of water source. As shown in Fig.7, there are a lot of wells in M1. However, those have been used as supplementary water resources during survey in this area.

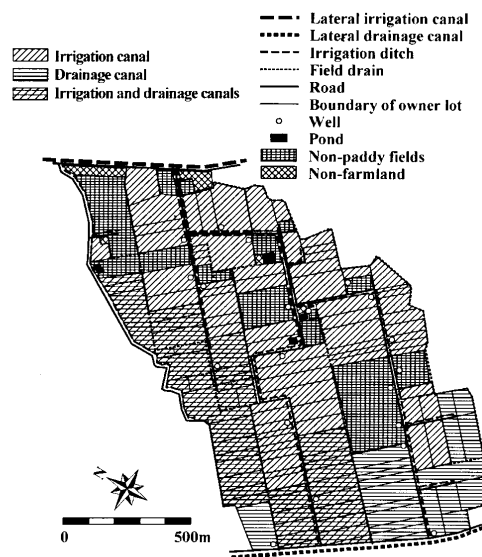


Fig.7 The spatial distribution of water sources for irrigation during the preparation season for dry-season rice cropping in M1.

Table 3 The ratios of the areas by water sources

Water sources	(%)		
	U	M1	M2
Irrigation canal	84	56	75
Drainage canal	15	18	24
Irrigation and drainage canals	1	26	1
Total	100	100	100

## 5. DISCUSSION

### 5.1 Water distribution

According to the water distribution plan, water masters and zone men are responsible for water distribution within lateral canals. However, our observation shows that most of the intake gates for the irrigation ditches have been broken and thrown away in this project including three survey areas. Since it is very difficult to stop farmers from operating or breaking gates and to keep them from getting water with private pumps, the adjustment of the water level by operating check gates in lateral irrigation canals is the only way to control water distribution to the irrigation ditches. Under this condition, uneven water distribution easily arises, resulting in an advantageous position for upstream ditches. As shown in Table 2 and Fig.6, U finished the preparation for the dry-season rice cropping in the shortest period among the three survey areas because they took more water. As our

results indicate, even within the ditch level, upstream farmers have priority in using the water. It is difficult to distribute water evenly at any level. This should be considered in the discussion on how to establish farmers' water management organization.

### 5.2 Reuse of drainage water

In this project, irrigation water for the dry-season rice cropping is alternately distributed for the achievement of equity among the farmers. However, the target area is limited to only the upstream area of the lateral irrigation canals. The reason is the difficulty in distributing water to the downstream areas of the canals because upstream farmers take too much water. As a consequence downstream farmers use drainage water by checking the field drain or by pumping from a lateral canal, and they are able to do the dry-season rice cropping.

According to the field survey at the survey areas, irrigation water is insufficient in the downstream plots during the preparation period for the dry-season rice cropping. However, all water drained before the start of broadcasting, as well as seepage from upstream plots is used in the downstream plots. Thorough reuse of the drainage water contributes toward the increasing area of the dry-season rice cropping, and moreover, achieving high irrigation efficiency.

### 5.3 Developing farmers' water management organization

The establishment of a farmers' water management organization is one of the approach adopted by Thai government. However, farmers' water management organization activities in the survey areas aren't very active.

For example in **M1**, farmers participate in maintenance activities of the irrigation ditches and field drains. However, the cleaning and dredging of them are irregular. When some influential farmers propose to clean the canals, they contact each other and collect money. In the case of **M1**, 20 baht/rai (1baht  $\approx$  3yen, 1rai  $\approx$  0.16ha) for an irrigation ditch and 50 baht/rai for a field drain are collected from the beneficiary farmers, and then a dredging machine is employed. However, farmers in the tail end parts of the irrigation ditches don't participate in the dredging activity because they can't take water through the irrigation ditch as shown in Fig.7. Each irrigation ditch and field drain is maintained independently because each beneficiary farmer is different. In this way, the maintenance of irrigation ditches and field drains are performed but not systematically.

In addition, farmers can't find a strong common need for water. Some in **M1** finished their preparation in advance of irrigation for the dry-season rice cropping. Others can use drainage water, and moreover, wells as supplementary water sources. It reduces the incentive for cooperation in getting water from the lateral irrigation canal. A farmers' request for the water and their position are so heterogeneous that finding an incentive to establish

a farmers' water management organization is difficult without strong action from the outside, such as governmental subsidy to farmers for their cooperation in water management.

## 6. CONCLUSIONS

- 1) The planned target area was situated around the main and lateral irrigation canals and it didn't extend to the downstream area of the lateral irrigation canals or irrigation ditches. However, downstream farmers, out of the target area, could plant rice by the use of irrigation water for domestic and upland crop purposes, the use of drainage water and well, and the use of supplied water more than planned. These contribute to increasing the area of the dry-season rice cropping.
- 2) In the upstream area of a lateral canal, the rice planting finished in about 40 days, whereas it took more than that in downstream areas. At the on-farm level, some plots near a lateral irrigation and drainage canal use various water sources. As such, upstream farmers have an advantage in taking water.
- 3) Even within the beneficiary area of an irrigation ditch, the timing and the water sources for rice planting are various. When rice is planted, some upstream farmers use domestic water before the irrigation for the dry-season-rice cropping reaches, while downstream farmers use the drainage water or wells. These variations in both the timing and the water sources for rice planting makes the farmers difficult to cooperate within the beneficiary area of an irrigation ditch.

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[Questions and/or discussions on this paper for public debate will be accepted before Jun. 24. 2002]

## タイ国チャオプラヤデルタ上流域における水管理

-ボロマタ灌漑プロジェクトにおける水利用の分析-

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## 要 旨

本研究では、チャオプラヤデルタ上流域における圃場レベルでの水管理を詳細な現地調査に基づいて明らかにし、農民水利組織の発展を含んだ水管理の問題点を検討する。水管理において重要な役割を期待されている農民水利組織は、タイ政府が体系的な水管理計画を作成しているにもかかわらず十分に機能していない。農民に公平な取水機会を与えるために、タイ政府は乾期稲作付け可能地区（ターゲット地区）政策を実施しているが、農民の取水活動を管理することが難しく、十分に成功しているとはいえない。調査によると、支線用水路、末端用水路の両方において、その上流農民は有利に取水を行っており、支線用水路上流地区では乾期稲の作付けを3調査地区のなかで最も短い40日程度で終えた。末端用水路下流農民は、用水路に水が十分でないため、支線排水路から排水を揚水したり、圃場排水路を堰上げしたりして排水を反復利用している。徹底した排水の反復利用が乾期稲作付面積の増加に寄与していることは明らかであるが、一方では、作付け時期および水源の多様性が末端用水路受益農民同士の協力を難しくしている。

キーワード：水管理，農民組織，RID，反復利用