

Participatory Management Structure of Large-Scale People's Irrigation System: The Case of the Soprong *Muang Fai* System, Northern Thailand

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Abstract

The purpose of this paper is to analyze the management structure used by farmers in a large-scale *muang fai* irrigation system in northern Thailand in developing, managing, operating, and maintaining their irrigation system. A qualitative analysis of empirical data on the historical development, physical conditions, water distribution and maintenance practices as well as the organizational management of the Soprong *muang fai* group revealed that this system uses a participatory management structure. In order to cope with the large number of irrigation water users and widely dispersed irrigation areas, social organization, based on a village representation system, precedes hydraulic manipulation. Village irrigation delegates are nominated by village irrigation water users and endorsed by their village headmen to participate in inter-village irrigation management planning and to take charge of irrigation management within their villages. The effectiveness of this management structure hinges on the skills of the delegates and the *muang fai* manager, who is directly elected by members and thus accountable to all irrigation members regardless of their villages, in building a consensus on a practical inter-village irrigation management plan. The existence of a forum in which the delegates meet reduces information asymmetry across villages regarding water requirements and availability as well as physical and human conditions, and any issues that may cause distrust can be worked out. The common goal of the forum is to treat every village irrigation group and irrigation user equally by providing all of them with necessary irrigation water and with a clear, common water management, maintenance and cost-sharing plan. This plan, subsequently announced publicly by the *muang fai* manager as the agreement of the *muang fai* group, frames how each village irrigation delegate should organize the water management and maintenance in their respective villages and contribute to the Soprong group. The status of village irrigation delegates is such that they can use social sanctions against potential violators of the agreement with support from the *muang fai* manager and village headmen as needed. The peculiar distribution of canal maintenance costs in this system points out the delicacy needed in applying the principle of equality in large-scale systems.

Keywords: *muang fai*, participatory irrigation management, institutionalism, community irrigation system, economy of scale, social organization, irrigation information asymmetry, natural resources management

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Introduction

Irrigation management is a complex applied science that is always challenged by diverse conditions in real life. To optimize irrigation management, irrigation managers need diverse temporal and spatial information regarding crops, including their types, growth stages and water requirements; farm conditions such as land formations, soil types, and locations and access to irrigation water; and actual weather conditions in the entire irrigation system as a basis for creating a water management plan that is highly responsive to field conditions in real time. The managers also need all of the water users in the system to follow their water management plan and maintain the irrigation facilities in good condition. However, in real life, to gather such information is labor-intensive, especially in an open channel gravity irrigation system serving a large number of small farms like the irrigation systems in Thailand, and it is difficult for the irrigation managers to handle this task alone. Some managers can afford sophisticated, expensive information technology but, without the absolute power to control the behavior of water users, they still cannot make their water management plan effective and efficient and the irrigation system sustainable.

Participatory irrigation management is a promising solution for optimizing irrigation management. Its potential is well recognized across the world, but there is still a lack of knowledge about how to encourage participation in government-funded irrigation projects where efforts to do so have not borne good results. Tapping the local wisdom of farmers who have been successful in managing and sustaining their self-reliant irrigation systems over a long period of time can create a body of knowledge and a participatory approach for government-funded irrigation systems. In the mountainous northern region of Thailand, there are many traditional *muang fai* (literally, weir and ditch) irrigation systems that are run by the farmers themselves. No complete statistics are available on their total number, location and coverage. Whether these systems use only primitive technology or highly sophisticated technologies that incorporate insights on efficiently utilizing limited water resources has been a subject of debate [Falvey 2001; Tanabe 1994]. To settle these debates, more studies are needed, but they are outside the scope of this paper.

This paper focuses on the fact that these farmer-managed systems have effectively served their users for centuries [Sirivongs 1983; Surarerks 1986; 1991: 185–217; Tan-Kim-Yong 1995; and Vichienkhieu *et al.* 2003: 120–142], and that, amazingly, some of them are relatively large, traversing many levels of social systems including villages and even *tambons* (sub-districts), which represent the first level of formal unit in the local administrative system and comprise several villages. The existence of these large-scale systems defies the general claims of government hydraulic bureaucrats who assume that farmers

can only organize themselves to manage small-scale systems and thus can organize themselves to manage only lower-level and/or small parts of large-scale government-funded irrigation systems, such as the on-farm irrigation system. These systems require careful management that enables self-reliant farmers to cope with a large number of participants and widely dispersed irrigation areas successfully and over a long period of time. This paper represents the continuation of a study of the small-scale Pongsak *muang fai* irrigation system in Mae Hong Son province [Ounvichit *et al.* 2006]. That study concluded that the system is sustainable because a sizeable membership is maintained through strictly equal and transparent treatment of *muang fai* members in their intake-based water and cost sharing system.

Study Methodology

Following extensive reconnaissance surveys of *muang fai* irrigation systems in the northern region of Thailand, it was concluded that the level of human interface can be used as the criterion for classifying the scale of the *muang fai* systems. In small-scale *muang fai* systems, irrigation water users know each other and directly participate in the irrigation management. Their leaders personally know every water user, and are thoroughly familiar with the field conditions and other information pertaining to irrigation. On the other hand, in large-scale *muang fai* systems, it is not possible for all water users in the system to know each other. Their leaders also cannot afford the time and resources to get to know every water user because the number of irrigation water users is so large, with some residing in different communities, or to become familiar with the field conditions of the large number of farms scattered over a wide region.

Among a few large-scale *muang fai* systems covered in the surveys, the Soprong *muang fai* system in western Chiangmai Province was selected as the study case for its potential to reveal a fairly systematic, and hence comprehensible, participatory management structure. Field surveys were conducted to elucidate its physical conditions, including its topography and meteorology, its irrigation structures and their functions, as well as its socio-economic conditions, including demography, and social and farming systems. Information on its historical development and management, including its organizational and management structure, irrigation operation and monitoring, and maintenance arrangements, was obtained from the *muang fai* management team. The informants included the former and present *muang fai* managers and six village irrigation delegates, selected based on their availability and their distribution in the upper and lower reaches of the irrigation system. An analysis was conducted to identify the characteristics, underlying principles, effectiveness factors and peculiarities of its participatory management structure.

General Features of the Irrigation System

The headwork of the Soprong *muang fai* system is a rock-filled weir located in Soprong Village Moo 5 of the Tambon Nongtong Municipality in Hangdong District, west of Chiangmai City. The weir height varies from 1.5 to 2.8 m. Its length is 80 m spanning the Ping River. Originally, in this locality, there were two wooden weirs, the Soprong and Rongkruakham, which had been in existence for at least 300–400 years. They were merged and strengthened in 1978 to form the present Soprong weir under a state-funded project on the condition given by the members of the wooden weirs that the state would not take the management of the system over from them.

The Soprong system supplies irrigation water to 937 ha of land on the right bank of the Ping River in Sanpatong District in the south of Hangdong District. Most of the service area is in Tambon Maeka, with a few areas in nearby *tambons*. Tambon Maeka communities expanded extensively after residents of the then-Ban Nongtong in Hangdong District, where the weir is located, migrated and settled permanently in their farming area in Tambon Maeka in 1948 and built the first community temple in 1949. This part of Sanpathong District is situated in a rain shadow area and has insufficient rainfall for agricultural purposes. The rainfall and evaporation records as summarized in Fig. 1 show that this area has an average monthly rainfall above the average monthly evaporation rate only in September, and there is a strong need for irrigation for wet rice production. However, the Ping river in this area has a catchment to bring to the headwork an annual discharge of 760 MCM [Chiangmai Provincial Irrigation Office 1999]

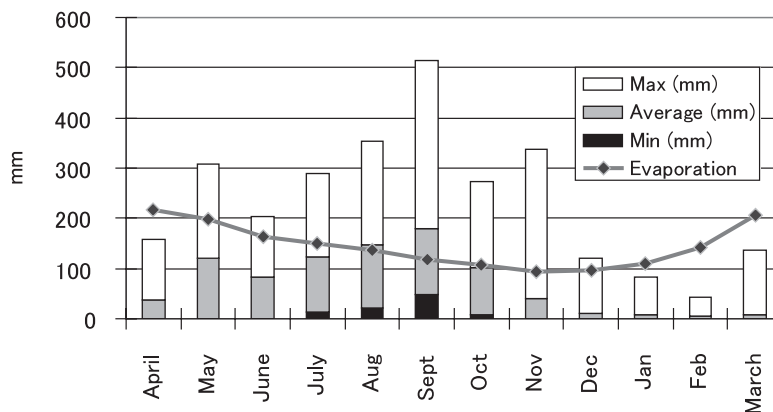


Fig. 1 Average Monthly Rainfall and Evaporation in the Sanpatong District (53-year average of 1952–2004 for rainfall and 20-year average of 1985–2004 for evaporation)

Source: [Upper North Hydrological and Water Management Center of the Royal Irrigation Department of Thailand 2004] and Thailand Meteorological Department, 2005.

or an annual average of 25 Cusec, which was confirmed to be sufficient by local farmers, so that they have never had water shortages owing to the river flow itself, even in the dry season. Thus, if any water shortage problem were to occur, it would be related to whether the diversion weir could get enough water. As long as the farmers constructed and maintained the weir properly, they did not have water shortage problems. Rather than water shortages, this area used to suffer from floods. Prior to the construction of the Mae Ngat reservoir in 1985 upstream of the Soprong system, farmers could practice farming only after the flood flows receded. The Mae Ngat storage dam has lessened the flood problems, stabilized water availability, and given farmers confidence in farming wet and dry season crops.

The Soprong irrigation system distributes water through its 7.8 km-long main canal, which traverses 12 villages in Tambon Maeka, Tambon Thungtom, Tambon Makhamluang and Tambon Makhunwan in Sanpatong District, Chiangmai Province. See Table 1 for village names and areas, irrigation areas, and irrigation membership. The main canal fans out into nine lateral canals, each of which serves one or more villages. Local farmers are very careful to provide sufficient drainage capacity in this formerly flood-prone area. There are a number of waste ways that drain both the excess flow in the main canal and side flows from the western mountains down to the Ping River in the head-end of the main canal in order to prevent damage to the irrigation system.

Farming is the major occupation in the area. Eighty-nine percent of Soprong members are land owners. Their average land holding is 1.27 ha. In the lowland, paddies can be cultivated twice a year. Crops are being diversified into longan, mango, papaya, and many kinds of upland and vegetable crops over approximately 35% of the service

Table 1 Village Names, Irrigation Areas and Membership of the Soprong System

No.	Village	Tambon	Village Area (ha) ¹⁾	Irrigation Area (ha) ²⁾	Irrigation Members (persons) ²⁾
1	Sanpong	Maeka	73	45	42
2	Saimul	Maeka	119	41	49
3	Sankhokchang	Maeka	112	49	55
4	Mae Khongtai	Maeka	253	287	158
5	Mae Khongklang	Maeka	73	87	77
6	Rongkhut	Maeka	106	39	54
7	Mae Khongnua	Maeka	48	78	40
8	Maeka	Maeka	140	40	24
9	Pakluay	Maeka	107	82	77
10	Mae Kungnoi	Thungtom	103	40	37
11	Dong Khilek	Makhamluang	118	68	57
12	Dong Pasang	Makhunwan	184	81	70
Total			1,436	937	740

Source: ¹⁾ Tambon Maeka Administrative Organization for villages in Tambon Maeka and interview data due to unavailability of official data, 2007.

²⁾ [Chiang Mai Provincial Irrigation Office 1999]

area [*ibid.*]. This crop diversification has reduced the irrigation water demand and introduced the furrow and lift irrigation methods into the area, allowing farmers to keep water stock in their furrows and ponds and lessening irrigation time conflicts among the farmers. Now that the system has begun to have a high water surplus, farmers at the tail end of the main canal, such as at Ban Rongwua village, who left the Soprong system in 1981, have expressed interest in re-joining the system to supplement their irrigation water from the public Mae Taeng irrigation system during the dry season, when the irrigation rotation schedule of that system does not succeed in bringing reliable water supply to their village, which is located 50 km from its headwork.

Management Structure

Inter-Village Irrigation Management Planning: The Core of Participatory Structure

Organizationally, the management of the Soprong irrigation system is led by the *muang fai* manager, who is directly elected by irrigation system members. The manager appoints an assistant and employs a villager residing near the weir to look after it. In a system with a 937-ha irrigation area and 740 members, the manager cannot afford to work directly with every member as in a small-scale system. At the same time, it is difficult for the members to keep informed about what he is doing. In addition, the manager does not have the resources to obtain precise information about each member and his/her farm nor the time and place information needed to manage the irrigation system. Among the members themselves, the probability of information asymmetry is also high and can create the suspicion that some members are taking advantage of others. In severe cases, this distrust can lead to the collapse of the *muang fai* group. To overcome this problem, the *muang fai* manager creates a participatory management structure as shown in Fig. 2. In this structure, irrigation members in each of the 12 villages nominate delegates to work with the *muang fai* manager. These 12 delegates are endorsed and supported by their respective village headmen. The first mission of the delegates is to organize the water users in their villages. Irrigation water users in villages where the number of water users is not substantial can be included in the irrigation organizations of nearby villages.

The village irrigation delegates support the *muang fai* manager by supplying information from their villages that is needed for irrigation management. However, in their capacity as the “delegates” of their villages, their most important duty is to obtain and defend the water allocation for the irrigation members in their own villages, as well as the duty allocation for their villages. As a result, the *muang fai* manager is faced with the problem of whose information he should use when they are in conflict. To solve this problem neutrally, the *muang fai* manager convenes an annual inter-village irrigation water management planning meeting. Every village irrigation delegate is requested to present, cross-check and harmonize their information and build a consensus on how the

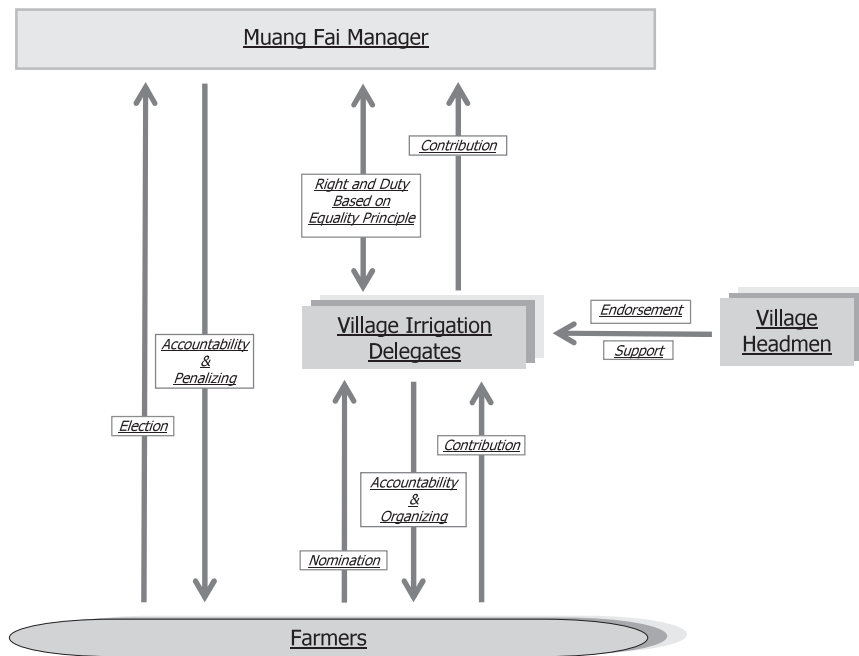


Fig. 2 The Participatory Management Structure of the Soprong System

Soprong system can be jointly managed by the village groups. This consensus-building process is different from a state public hearing or announcement of the state irrigation management plan because it is a process of joint decision-making, not one of a decision announcement or of public relations. The trust that the *muang fai* manager has gained from members through direct election ensures his accountability to every member, regardless of which village that member lives in. He is bound to pre-empt the possibility of conflicts [Bell 2001: 79–104; Vattanasap 2001: 59–78], which he did by holding to the principle of equality for every member and every village irrigation group in getting the necessary irrigation water.

The annual inter-village irrigation management planning meeting is the most crucial management instrument for this large-scale irrigation system. Only through information exchange, negotiation, mediation, and consultation can the information be pieced together, information asymmetry among the delegates be reduced, and a common information ground created to formulate a joint irrigation management and cost distribution plan. The *muang fai* manager has the mandate to declare the plan to be the final agreement that every village irrigation delegate who participates in the meeting has to abide by.

The agreement is delivered to the *muang fai* group through two channels, informally by the delegates who inform their members separately and formally by the *muang fai*

manager at a general assembly, held in January and/or June, at the residence of the *muang fai* manager or at a temple in the village where the manager resides. At the assembly, a report is made on the condition of the water and irrigation facilities and the group fund status; also, the annual working plan and seasonal water distribution plan are presented and an opportunity is given to the members to express their opinions. However, since the water allocation and resource mobilization plans have become stabilized over the years, an increasing number of members prefer to leave these matters to their village irrigation delegates to handle, and the number of members attending the assembly is declining. The conspicuous absence of members at the assembly is presently threatening the participatory management structure of the Soprong group, which maintains its integrity and its ability to pursue justifiable and achievable common goals through the continuous triangular relationships among the village irrigation members, village irrigation delegates, and the top *muang fai* manager.

Village Irrigation Delegates: Intermediaries and Beyond

The village irrigation delegates do not act merely as intermediaries between village groups, but as the authorized delegates of the village irrigation members whose function is to obtain and defend the water allocation for their village irrigation groups during inter-village irrigation water management planning. To effectively perform this work, the delegates must have accurate information on the farming conditions, water requirements and irrigation facilities in their villages. As there is a chance that their data and requested water allocations may be in conflict with those of their counterparts from other villages, the delegates, at the annual inter-village irrigation water management planning meeting, must talk through the conflicts, mediate the conflicting delegates, and build a consensus on water management, or a win-win solution, which is a rational approach to participation [Vattanasap 2001: 59–78; Phanthasen 2001: 291–322]. After the consensus on the joint water management and cost sharing is announced as the final agreement by the *muang fai* manager, the delegates must continue as monitors of the implementation of the plan, especially during water shortage periods, and must seek justice from the *muang fai* manager if violations occur to the detriment of their members. In addition, they are also obligated by the inter-village irrigation agreement to mobilize resources from their villages to help maintain and repair the irrigation system together with other villages.

The village irrigation delegates play a crucial role not only in the inter-village irrigation management, but also in arranging for an irrigation water management agreement inside their own villages, which must be in compliance with the system-wide plan. Their ability to understand the hydraulic, farming and social dimensions of the system is the key to making the intra-village irrigation management process work without alienating any members, nor undercutting the inter-village irrigation management process. In some villages, the delegates are also in charge of operating major

irrigation and drainage structures, as conflicts might occur if individual members were allowed to freely operate these structures. The delegates oversee the intra-village operation and mediate conflicts or constraints that may occur from time to time. Their tasks are rather tedious, comprising daily, seasonal and annual tasks. Managers who undertake this type of management must be more responsive than managers working in a bureaucratic system during office hours.

The village irrigation delegates have many tasks to perform, but their remuneration is not substantial. What, then, motivates them to accept the tasks and makes them successful in performing the tasks? The often-heard claim in the bureaucratic circle that tertiary and secondary irrigation canal groups in government-funded irrigation systems cannot function effectively because their leaders are not paid is not necessarily true. In the present case study, the economic benefit each manager gains from accepting the job is not substantial. The person who gains the highest remuneration is the top *muang fai* manager. However, the amount he gains, a mere US\$937 per year, is much less than the amount a government officer with equivalent duties would be paid. Most of the village irrigation delegates make only about US\$50 per year for performing these duties.

This low pay suggests that the social recognition or trust that the delegates gain from their fellow villagers is the actual reward for them. In turn, such recognition and trust becomes the instrument that enables them to successfully solicit cooperation from their irrigation members and bring about orderly water utilization. Their “delegate” status arises from the social system, unlike that of canal leaders in the government-funded irrigation systems that are created under a hydraulic system. They can impose penalties on any members who are not cooperative and who violate the intra- and inter-village irrigation agreements. The socially sanctioned relationship between the village irrigation delegates and village irrigation members is different from the relationship between the government irrigation officers and farmers in government-funded irrigation systems. In the latter systems, there is no such mechanism for social sanction because the farmers consider the officers their free service providers, not their delegates. If the village irrigation delegates do not gain cooperation from some members, they can choose to abandon the job, an event that other cooperative irrigation members will not allow to happen. The triangular relationships among the village irrigation members, village irrigation delegates and the *muang fai* manager are difficult to cultivate; hence, the village irrigation members try to keep their village irrigation delegates and the *muang fai* manager in their positions as long as possible, as proven by the fact that the terms of these positions are not predetermined and most of the *muang fai* managers and delegates hold the positions throughout their lifetimes or until they resign for personal reasons.

Social Relations in Hydraulic Management

The use of the village as the basic unit of irrigation management reflects the fact that the

Soprong *muang fai* group has placed people and the communities they live in at the heart of the hydraulic management system. This practice coincides with a school of belief that views the village potential as the key to improving people's livelihood [Nartsupha and Lertvicha 1994: 5; Nozaki and Baker 2003]. In the present case study, villages are shown to still be fairly strong, as proven by the frequency of village meetings. For example, the Mae Khongtai village held over 10 formal village meetings during the past year to consider many important issues. Irrigation systems serve people. However, people naturally have diverse attributes or motivations. There is thus a need to unify them in some way so that they can work together on agricultural water problems. Instead of using one of the irrigation facilities, such as the tertiary, secondary, or primary canals or headwork as the basis for organizing people as in most government-funded irrigation systems, the Soprong *muang fai* group uses the village, a social unit, to organize its members. Only after the villagers organize do they formulate a detailed joint hydraulic management plan. When an irrigation management plan is developed through a social process such as the one in this system, it is effective and sustainable because it is respected by the people who have created it. The efficiency of the plan is influenced by the quality of the information regarding hydraulic conditions that the people, or their representatives, possess and/or comprehend, and by the technology in use.

As mentioned earlier, a decline in the number of attendees in the Soprong general assemblies resulting from the stability of water management plans that have been in place for years may harm the triangular relationship among the *muang fai* leader, village irrigation delegates and village irrigation members. The Soprong *muang fai* group is looking for more and more assistance from local governments for the repair and improvement of their irrigation facilities. A similar phenomenon is also taking place in a traditional irrigation system that has been modified into a participatory irrigation system in Japan. The management teams of the Manno-ike irrigation system also tend to seek more support from the state and local governments [Ounvichit and Klaymon 2001]. Several studies have been conducted on ways to conserve the traditional participatory systems. Recommended measures include networking the systems so they support each other, preserving their self-determination strategies, accepting joint management with public agencies, monitoring the impact of government actions on their systems using local organizations, and amending related laws to support the autonomy of the traditional systems [Tan-Kim-Yong 1995; Atharn 1995; Nimmanhaeminda 1989].

In the case of Soprong, the present country-wide administrative reform in Thailand is giving local governments greater authority in charting their local development plans and a larger proportion of development budgets from the state coffers. This new context will make local governments a new participant in the *muang fai* management structure and is likely to increase the visibility of the *muang fai* system to the local community and enhance the integration of irrigation with other related local sectors such as agriculture and water resources management. However, the relationship between the *muang fai*

group and local governments must be clarified so that the irrigation system can continue to render the highest and most equitable benefits to all irrigation members over the long term.

Economy of Scale in Maintenance and Management

Financially, the management team of the Soprong system is presently authorized by the members to collect irrigation assessments from *muang fai* members at the rate of US\$0.72 (at the exchange rate of 35 Thai baht per US\$, also used below) per 0.16 ha or 1 *rai* per year. This rate has been increased periodically from US\$0.43 to US\$0.57 in 2005 and to US\$0.72 in 2006 to cover maintenance and improvement necessities. The assessment payment has nominal importance because it signifies the membership of the payer and guarantees him/her the right to share irrigation water from the Soprong system. As crop diversification is generating higher income, there have been discussions between paddy farmers and high-value crop farmers on whether the assessment is too low or too high.

The village irrigation delegates are in charge of collecting the assessments and bringing them to the *muang fai* manager, who allocates the total in the following way:

- US\$0.17 to the *muang fai* group fund to be used for maintenance of common facilities, including the diversion dam, and the main and lateral canals
- US\$0.20 as lump sum remuneration for the *muang fai* manager
- US\$0.20 as lump sum remuneration for the respective village irrigation delegate
- US\$0.12 as lump sum remuneration for the assistant to the *muang fai* manager
- US\$0.03 as lump sum remuneration for the weir tender

This *muang fai* system has clearly achieved an economy of scale in maintenance and management when compared with the small-scale Pongsak *muang fai* system [Ounvichit *et al.* 2006]. When the monetary assessment and labor contribution costs for maintenance are combined by applying the penalty rate for absence on the maintenance days and assuming that the total number of maintenance days is three, the annual maintenance cost per ha in this system is US\$15.22, or only 8% of the cost of the small-scale *muang fai* system, which is US\$187.20 per ha per year. When all remuneration costs are combined and treated as the management cost of the system, the total is US\$3.44 per ha, or only 57% of that of the small-scale system.

Irrigation Operation: Agreement and System-Wide Harmonization

According to the inter-village irrigation management agreement, in normal time, irrigation water is to be supplied continuously and simultaneously to all. *Muang fai* members are not allowed to temporarily block and divert the water flow in the main canal into

their farms, as such practice would affect the continuous flow to other fields downstream of the check point. When there is water scarcity, the *muang fai* manager decides, after consulting with village irrigation delegates, on a fixed rotation schedule, which starts from the tail reach villages and moves upwards. The village irrigation delegates monitor whether the rotation is practically and strictly followed in the field. Violations of the rotation schedule are handled publicly by the *muang fai* manager himself, with the highest penalty of US\$57.14, but so far no violation has been reported.

Generally, the secondary canals, some of which are shared by two or more villages, supply irrigation water on a continuous and simultaneous basis. When water becomes scarce, related village irrigation delegates negotiate for a weekly rotation, which is subject to confirmation by the *muang fai* manager. For example, the Mae Khongtai and Mae Khongklang villages, which share a lateral canal, agreed that the former would use the irrigation water from Tuesday to Friday while the latter would use it on the other days. Extensive crop diversification and the newly introduced furrow and lift irrigation methods have changed the irrigation water demand pattern and reduced the necessity for irrigation rotation. Generally, no member is allowed to temporarily block the water flow in the lateral canal. However, some members can be permitted to do so after the related village irrigation delegates have confirmed that they need to do so due to topographical constraints. This special permission is limited to a one-night water check-up from 5 p.m. to 5 a.m. the next day.

At the on-farm level, farm owners determine the size of the irrigation inlets on their farms and the operation of the inlets by themselves. Normally, the width of the inlets is four to six inches, a size which was originally determined by using a traditional match box or *kapfai* as the measuring instrument. Larger sizes are not always preferable, even though the irrigation cost is not related to the farm inlet size. The Soprong system has no constraints in terms of water availability and irrigation system capacity; larger farm inlets would only result in the necessity for frequent inlet adjustments. Paddy farm inlets are in the form of simple cuts in the earth bunds. Inlets at other kinds of farms are in the form of pipe inlets.

Maintenance Arrangements: Influences of Scale, History and Local Conditions

To maintain their rights to use the irrigation water, *muang fai* members must pay an irrigation assessment, part of which is allocated as a group fund for the maintenance of the common irrigation facilities, including the weir, the main canal and the lateral canals that are used by more than one village. Members also contribute labor to maintain the facilities. The arrangement for the maintenance of the Soprong *muang fai* irrigation system is not strictly analogous to the arrangement in the small-scale Pongsak *muang fai*

irrigation system [Ounvichit *et al.* 2006], where the intake-based labor contribution was strictly equal in every category of maintenance work. In this large-scale system, the labor arrangement for maintenance work is influenced by the scale, the characteristics of the infrastructure, the skewed distribution of the irrigation area and membership, the quantity and difficulty of maintenance work and the historical development of the system.

In principle, every member is required to contribute to the maintenance work. However, it is not necessary that all members participate in the maintenance activities in practice as in the small-scale Pongsak system, because the maintenance work does not require that much labor. The economy of scale enables this large-scale *muang fai* group to establish a rule that every village group must send one laborer for every 1.6 ha (10 *rai*) of irrigation area. Members who have less than 1.6 ha are allowed to combine their acreage with other member(s) through personal arrangements by forming a unit and sending one person to work on their behalf, with acknowledgement from their village irrigation delegates. Some members can network and make agreement(s) with their fellow members. However, some members do not or cannot make such agreements, and thus have to work more than those who can. In this case, the number of workers will be higher than the number required by the village group. The village irrigation delegates, who are in charge of mobilizing the resources to fulfill the commitments of their village irrigation group, may then ask these members to act as substitutes for absentees or may reserve them to perform future maintenance activities for their village irrigation groups or for the *muang fai* group as necessary. Members who fail to contribute labor for maintenance purposes are subject to a US\$5.71 per man-day penalty. The village irrigation delegates can use these collected penalties to employ other labor to perform the *muang fai* group maintenance activities or for internal village irrigation activities.

The maintenance of the weir is normally scheduled in April, when the river flow is at its lowest. The appointment date and time are disseminated through the village irrigation delegates with support from their respective village headmen. The weir maintenance work is allocated to each village irrigation group in proportion to the irrigation area in their village and the scale of damage to sections of the weir. In the past, members were required to contribute two wooden stakes and two sand-filled bags per 0.16 ha (1 *rai*), but today the work does not require any additional materials. Only equipment to pull fallen rocks back to the weir is needed. The problem of how to decide which village should maintain the most difficult part of the weir, i.e., the mid-section, is solved by distributing work sections by drawing lots. Generally, the weir maintenance lasts 1–2 days.

The maintenance of the main canal is conducted twice a year, in January and May, before the start of the cropping season. The maintenance work on the main canal is allocated to each village in the upper reach down to the lower reach based on allocating a single one-meter section of canal per 0.16 ha of irrigation area. Once *muang fai* members

Sections of the main canal in the territory of village No.	The villages where the canal maintenance teams working on the sections come from											
	1	2	3	4	5	6	7	8	9	10	11	12
1	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4				✓	✓	✓	✓	✓	✓	✓	✓	✓
5					✓	✓	✓	✓	✓	✓	✓	✓
6						✓	✓	✓	✓	✓	✓	✓
7							✓	✓	✓	✓	✓	✓
8								✓	✓	✓	✓	✓
9									✓	✓	✓	✓
10										✓	✓	✓
11											✓	✓
12												✓

Fig. 3 Illustration of Canal Maintenance Work Allocation in the Soprong System

in a village finish the allocated work up until the last intake in their village territories, they do not have to continue working on the remaining canal section. Members in the lowest reach village must continue the work until the end of the main canal. The allocation of the work as illustrated in Fig. 3 is different from that of the small-scale Pongsak system, in which all members work together on the entire length of the main canal.

This canal maintenance arrangement is influenced by the economy of scale of this large-scale *muang fai* system that is biased in favor of villages in the upper reach, where the number of farmers and the acreage of the irrigation area are larger than those of the villages in the lower reach. Generally, in any scale of *muang fai*, there must be common facilities for which all the beneficiaries have to share the responsibility. Otherwise, the *muang fai* group would not have been established. The group is a reflection of the necessity of cooperation in irrigation development. Everyone in the group tries to reduce the burdens of construction, operation, maintenance and management, which leads to the tendency to invite other people to join for the purpose of cost sharing. However, if the burden on the invitee is too large, he/she will not join. On the contrary, there will be no strong necessity to increase the number of farmers if the burden is already relatively low. What facilities are to be treated as the common responsibility depends on the local conditions and the agreement of related farmers.

The historical merger of the two wooden weirs into the strengthened Soprong weir has an influence over how related farmers come to agreements on the common responsibility. The upstream and downstream village irrigation groups separately maintained their wooden weirs in the wide river. The merger lessened their weir maintenance costs. Thus, the new Soprong *muang fai* group could easily agree to treat the new weir as their core common responsibility. However, with the conveyance canals, the situation was

different. Prior to the merger, the upstream and downstream village irrigation groups separately maintained their main canals. The upstream village irrigation groups who previously did not need the lower sections of the main canal refused to accept these sections as part of the core common responsibility that they would share equally. Instead, at the merger, the capacity of the canal had to be enlarged to convey sufficient flow to the downstream villages. This increased the canal workload for the upstream village irrigation groups, and they insisted that the downstream village irrigation groups share the load. On the other hand, the downstream village irrigation groups used to clean the long main canal from their wooden weir down to their villages on their own. From their point of view, the agreement by the upstream village irrigation groups to work with them in the upper canal sections can be considered assistance. They are willing to share the workload partly because doing so would give them confidence that the sections are clean enough to facilitate water flow to their villages. Since the downstream village irrigation groups have smaller irrigation areas than the upstream village irrigation groups, the work portions distributed to them based on village irrigation area are rather small. In addition, the maintenance work in this system is not as difficult as that in the small scale Pongsak *muang fai* system, which is situated on rough terrain. Maximally, the village irrigation group that is furthest downstream could finish all the canal work within 1–2 days.

From the perspective of an outsider, the rule that upstream village groups can stop working on the remaining canal sections beyond their village territories appears to be unfair to the downstream village groups. However, from the viewpoint of insiders, equality can be translated into differentiated levels of participation. A similar interpretation was noted in Japan, where water users' associations for paddy farming prior to the enactment of the Land Improvement Law of 1949 made their agricultural water management decisions based on their group identities, which had evolved through the course of history and created the foundation for the Japanese community-based water management system [Japanese National Committee of the ICID 1996: 3]. A subtle interpretation of equality requires knowledge of the local conditions and the situations faced by the village irrigation delegates.

However, this peculiarity raises the question of whether such differentiated levels of participation as occur in a self-reliant, or private, large-scale irrigation system like the Soprong should be allowed to take place in a government irrigation project, which is funded, fully or partially, by taxes collected from all tax-payers. These funds are partly allocated to the irrigation sector under the expectation that the investment will improve the livelihood of the people and the economy of the country. If the answer is yes, what processes will be needed to ensure that the differentiated levels of participation are a justifiable interpretation of equality? If the answer is no, how can the project function to help raise all irrigation beneficiaries to a strictly equal status for further participation in and for the success of the government project? These are important diverging directions

that irrigation bureaucrats should carefully consider when engaging in advocacy in participatory irrigation management. Can economically, physically, and historically disadvantaged people have their voices heard if their counterparts have to depend on them, for example for their labor contributions for system maintenance [Shukla *et al.* 2002: 225–241], or on others? Some mechanisms must be established so a reciprocal relationship between the advantaged and disadvantaged groups can be developed so that they can participate equally in irrigation management.

The arrangements for the maintenance of the secondary canals in each village vary according to the agreement within the village irrigation group. For example, the Pa Kluay village irrigation members are allocated to maintain two meters of canals or drains per 0.16 ha up to their farm inlets. For the supply canal, they work from the head-end to the tail-end, but for the drain canal they work from the tail-end upwards to the head-end. The supply and drainage canals are of comparable lengths. Therefore, this arrangement is fair to the members because it ensures that the sections of the supply and drainage canals that they depend on have been properly tended. This arrangement is not the same as that of the Mae Khongtai village irrigation group, where the members clean their village lateral canal together, without allocating work portions to individuals or smaller groups. For the lateral canal that this village irrigation group shares with another village irrigation group, the two groups allocate a 30-m section to each group up to the last intake in the Mae Khongtai territory.

Presently, the *muang fai* group is facing the problem of reduced labor contributions for maintenance activities. The problem stems from the method for calculating the labor requirement, which allows for a rounding-off of land units below 1 *rai* (0.16 ha). For example, if a number of members combine their acreage for maintenance purposes and the result of the combination is 10.8 *rai*, they can round off the result to 10 *rai* (1.6 ha) and send only one representative to participate in the maintenance work. Since familial inheritance is fragmenting land into smaller pieces, more rounding-off is occurring, and as a result, fewer laborers are available for maintenance activities. Every 3–4 years, the Soprong *muang fai* group has sought and obtained assistance from the Tambon Sanpatong Administrative Organization for major maintenance and repair. Some Tambon Administrative Organization leaders believe that the Soprong *muang fai* system should be managed by the Tambon organization in line with the officially on-going local government reform that will increase the role of the Tambon organization in local development. However, the present Soprong management team resist this idea, as they believe that the organization cannot successfully solicit farmers' cooperation and does not have the capacity to thoroughly manage the irrigation system because many tedious tasks are required. They reject the idea that they should continue working under the Tambon organization's supervision. This situation did not unfold during the period of the survey and was not followed up on because it was outside the scope of this study, which focused on understanding how farmers manage their irrigation systems by

themselves.

Conclusion

The participatory management structure of the large-scale Soprong *muang fai* irrigation system comprises three levels: the individual members, the village irrigation delegates and the *muang fai* manager, all of whom have cross relations. The *muang fai* manager is related to all members regardless of their village, and must check and balance the cost and benefit to each village irrigation group by adhering to the principle of equality. The manager must work with the village irrigation delegates, as they have the common duty of achieving consensus on how to jointly manage irrigation matters based on the information provided by village irrigation delegates regarding local conditions and needs. In seeking water rights for their members, the delegates must promise, on behalf of their members, to share the costs of maintaining the system, costs which the members must cover. The delegates need cooperation from their members in implementing the intra- and inter-village irrigation management and maintenance plans, and have social sanction instruments, as supported by their delegate status and by the village headmen, as well as monetary penalty rules, as supported by the *muang fai* manager, to bring about this cooperation. The effectiveness of this management structure comes from four major factors, i. e., the principle of equality for all members, the accountability of the *muang fai* manager and village irrigation delegates to their members, the availability of a platform for information exchange and joint decision-making, and the reliance on the social system over the hydraulic system for the institutional arrangements. This case study provides lessons on the necessity for the careful treatment of the distribution of cost where an economy of scale is possible.

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