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REVIEW
Farmers' Willingness to Perform Maintenance Activities in Participatory Irrigation Management in Thailand

Tatsuji ONIMARU*

Rural Development and Planning Research Division, NARO Institute for Rural Engineering (Tsukuba, Ibaraki 305-0856, Japan)

Abstract
In developing countries of the Asian monsoon region, participatory irrigation management (PIM) was introduced in the 1990s so that farmers rather than government staff could be partly or wholly responsible for operating, maintaining and managing irrigation projects. Whether or not farmers continuously participate in maintenance activities depends on the degree of their willingness to perform such activities. This study reviews the objectives, achievements and significance of a series of our six research papers that use a range of methods to increase the willingness of farmers to engage in maintenance activities, and also summarizes future perspectives of PIM sustainability. The results of the research papers showed a practical method and a new perspective for an efficient increase in the willingness of farmers; firstly by choosing factors with a new indicator, "maximum effective number of target persons", and then improving details of how the chosen factors were encouraged by adding an incentive perspective with "no decrease in vested benefits". Conversely, to simplify the questions regarding the selection of encouraging factors, the papers disregarded conditions such as the time and cost required for encouragement. The first priority is therefore to clarify the content of incentives based on factors that should be encouraged. Second, the findings of the papers cover only the most fundamental factors associated with PIM sustainability. Therefore, to effectively and efficiently improve PIM sustainability, there is a need to analyze "factors other than willingness" that influence the inclination to engage in maintenance activities.

Discipline: Irrigation, drainage and reclamation
Additional key words: assistance project, evaluation, irrigation/drainage canal, sustainability, water users' organization

Introduction

In developing countries of the Asian monsoon region, rice production for food has increased to supply growing populations. Governments of developing countries actively plan and conduct large-scale irrigation projects, assisted by international aid organizations, because irrigation is an extremely effective means of increasing rice production (Faures & Mukherji 2009).

In such projects, government staff members initiate the operation, maintenance and management (OMM) of completed facilities including irrigation/drainage canals. This is different from the situation in Japan where farmers themselves implement OMM. In developing countries, it has been thought that only governments have the capacity to implement OMM for large-scale irrigation projects because such projects require significant capital investment, new technologies and other support (Groenfeldt et al. 1999).

However in developing Asian monsoon countries, where a number of small-scale farmers are the major beneficiaries of irrigation projects, it has been impossible to restrain farmers in upstream areas from taking excessive water. This has resulted in not only insufficient benefits of irrigation but also increased fiscal expenditures (Ishii & Satoh 2003). To resolve these problems, it has become necessary to allow beneficiary farmers to participate in OMM. Therefore, participatory irrigation management (PIM) was introduced in the 1990s so that farmers rather than government staff could be partly or wholly responsible for the OMM of irrigation projects.

However, PIM was introduced without enhancing the capacity of farmers who managed water users' organiza-

*Corresponding author: e-mail onimaru@affrc.go.jp
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tions, an implementing body of PIM, which is why problems including the malfunction of established organizations occurred (Svendsen et al. 2000). Therefore, one of the present issues is to improve the sustainability of the introduced PIMs.

Among several factors involved in OMM, the "maintenance of canals" is important because, unless continuously practiced, the function of canals gradually declines. On the other hand, whether or not farmers continuously participate in maintenance activities depends on the degree of their willingness to perform such activities. Therefore, increasing farmers' willingness is a significant issue that needs to be addressed. To accomplish this, methods such as offering incentives that suit factors to increase their willingness are required.

This study aimed to review the objectives, achievements and significance of our series of six research papers published with a range of methods to increase the willingness of farmers to engage in maintenance activities as well as summarizing future perspectives of PIM sustainability.

Objectives of the papers

The research papers are separated into three groups in terms of objectives.

The first group of papers (Onimaru et al. 2003, Shioda & Onimaru 2007, Teamsuwan et al. 2010) aimed to analyze the present support situation to establish water users' organizations using a Japanese-type PIM assistance project that exploits the knowledge of the stratified water users' organizations in Japan (Iwata & Okamoto 2000), already known as a successful PIM. This is due to the need for organizations equipped with continuously functioning mechanisms to be established as implementing bodies to encourage and increase willingness. An example is the Modernization of Water Management System Project (MWMS) conducted in Thailand, in which I was involved from the start (Fig. 1). Data for analyzing the present support situation were collected by fact-finding on the spot where the MWMS was conducted.

The paper of the second group (Onimaru & Satoh 2009) aimed to analyze the present state of evaluations of sustainability for eight Japanese-type PIM assistance projects in the Asian monsoon region, including MWMS. This is because analysis of the contributory and inhibitory factors specified in the evaluations may clarify factors influencing the willingness to engage in maintenance activities. Data for analyzing the present state of evaluations were collected by reading evaluation reports on technical cooperation projects published by the Japan International Cooperation Agency.

The third group of papers (Onimaru & Satoh 2011a, 2011b) aimed to find methods that could effectively increase the willingness of farmers to engage in maintenance activi-

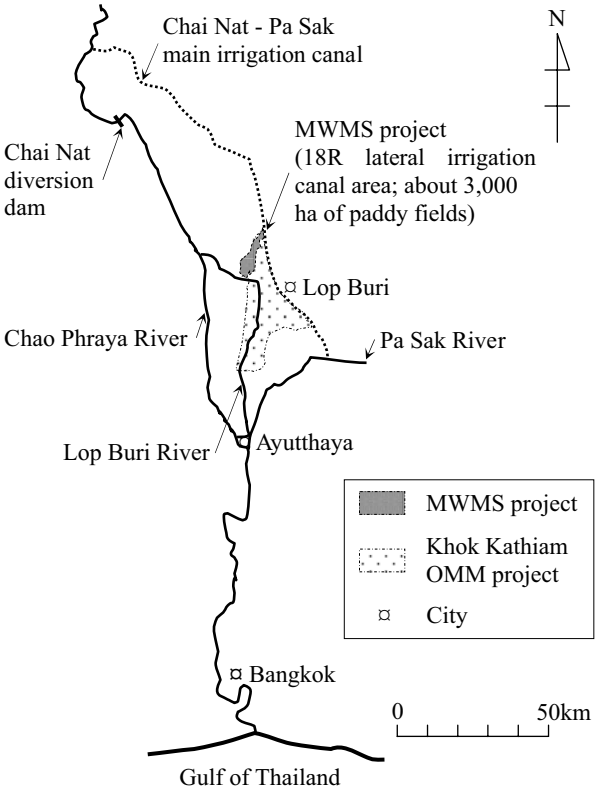


Fig. 1. Location of the MWMS project

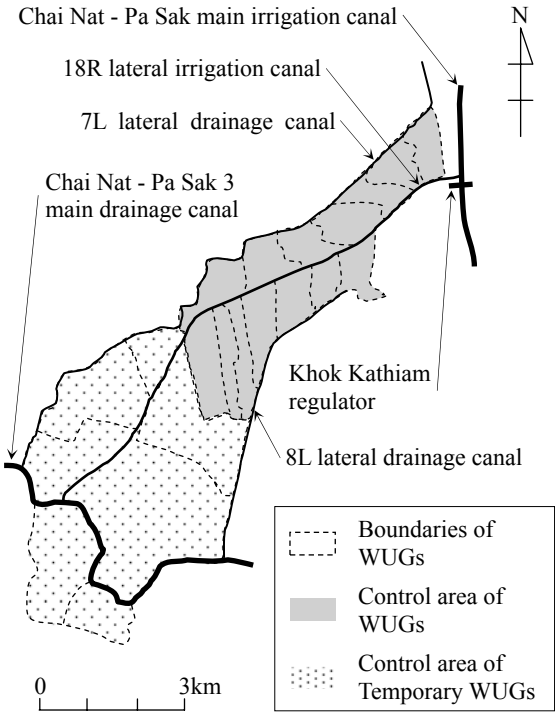


Fig. 2. Map of the 18R area

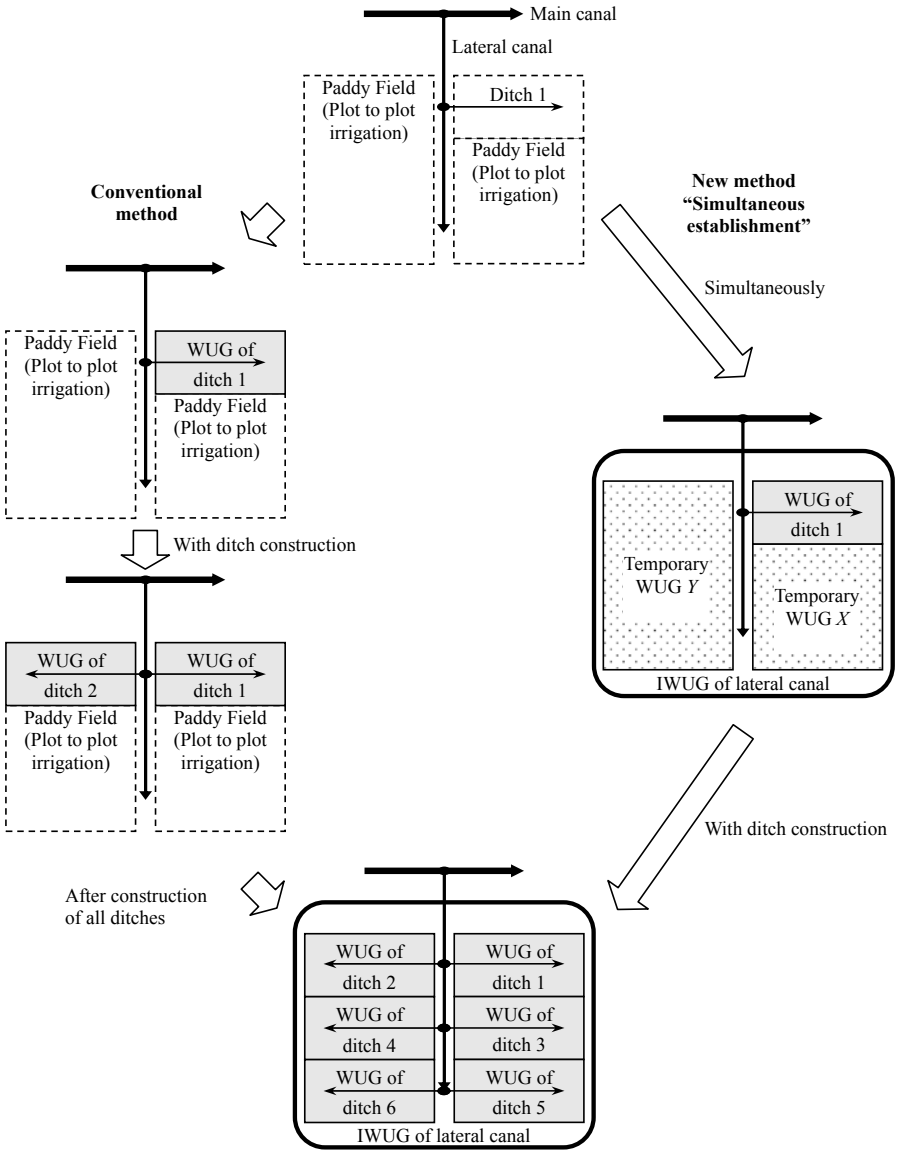


Fig. 3. Procedure for establishing WUGs and an IWUG

ties by conducting questionnaire surveys in the 18R lateral irrigation canal area where a MWMS was conducted (Fig. 2). This survey (Onimaru & Satoh 2011a) provided extensive material to analyze the relationships between the willingness of farmers and influencing factors.

Achievements of the papers

1. Analysis of the present support situation to establish water users' organizations

MWMS formulated a supportive plan that established water users' organizations with systems in which all farmers with common OMM-related interests could discuss and make decisions. To make the plan concrete, a Water Users' Group (WUG) responsible for the OMM was established for each ditch, and an Integrated Water Users' Group (IWUG), comprising all WUGs along the related lateral irrigation canal, was established at the same time (Fig. 3).

Moreover, the roles in the operation of irrigation facilities such as gates were designed according to the type of canal (lateral canal or ditch) and the type of operation (decision-making, daily operation or monitoring) (Satoh et al. 2007).

Consequently, in 2009, eight years after the establishment of the IWUG in 2001, the lateral canal and ditches were well maintained and functioning (Fig. 4), although so-called "upstream-downstream problems" (conflicts between upstream and downstream farmers related to water distribution) persisted. It is rare to see WUGs and an IWUG function for a long time in Thailand and other developing countries in the Asian monsoon region, suggesting that MWMS provides a good example of successful assistance projects.

Fig. 4. Change in the condition of a ditch in the 18R area
(Left: Just after construction, as of Aug. 2000)
(Right: 9 years later at the same ditch, as of Sep. 2009)

2. Analysis of the present state to evaluate sustainability in a Japanese-type PIM assistance project

Analysis to evaluate sustainability in eight Japanese-type PIM assistance projects including MWMS revealed the following: 1) The correlations between each evaluation indicator are not clear. Therefore, activity for achieving an indicator may unintentionally retard the achievement of another indicator if those concerned with the project do not adequately recognize said correlation. 2) Although contributory and inhibitory factors are shown, and the mutual relationship of factors and reason for the phenomena observed at the time of evaluation are not shown, the sustainability cannot be accurately determined.

Therefore, the present evaluation was not necessarily effective for clarifying the factors influencing the willingness to engage in maintenance activities.

3. Finding methods for effectively increasing the willingness of farmers to engage in maintenance activities

Because the present evaluation of sustainability was not effective for clarifying the influencing factors, we investigated factors influencing the willingness to engage in maintenance activities based on past research and then analyzed the relationships between the willingness and influencing factors using rank correlation coefficients based on qualitative data obtained from a questionnaire given to 202 farmers in the 18R lateral irrigation canal area.

Consequently, the following was observed: 1) Seven factors (awareness of the benefits of irrigation facilities; awareness of the benefits of irrigation water; sense of duty to the group; anxiety over the distribution of irrigation water; awareness of owning irrigation facilities; awareness of the need to engage in maintenance activities; reliability of members in the same WUG) directly influenced the willingness of farmers (Onimaru & Satoh 2011a). 2) In the 18R area, farmers with high willingness also had high awareness of the benefits of irrigation facilities, and anxiety over the impact on water distribution caused by damage to the canals.
3) Incentive perspectives of "increases in benefits" and "no decrease in vested benefits" such as easing anxiety need to be added.

Furthermore, even though the existing evaluation indicator cannot be used, the analysis revealed the use of a new indicator, "maximum effective number of target persons", which is an application of the cross table of influencing factors and willingness to engage in maintenance activities, allowed us to select influencing factors that increased willingness.

The word "effective" in the above indicator means "to effectively increase the willingness of farmers to engage in maintenance activities".

We derived this indicator as follows:

First, we assumed that the above seven factors (hereafter called factors 1-7) exert an independent positive influence on the willingness to engage in maintenance activities among farmers belonging to a water users' organization.

Next, we arranged data related to each factor, and the corresponding degree of willingness obtained from a questionnaire survey of farmers into a 2 × 2 cross table (Table 1), where

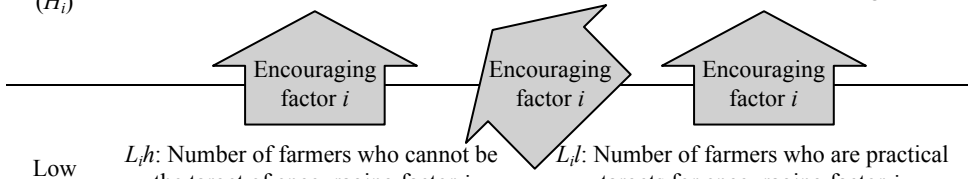
- i indicates the factor number (1-7);
- H_i and L_i indicate the number of farmers who responded "high" or "low" with respect to factor i;
- h and l indicate the number of farmers who responded "high" or "low" with respect to willingness;
- and, $H_i h$, $H_i l$, $L_i h$, and $L_i l$ indicate the number of farmers within each cell.

Here, $H_i h$—where both factor i and willingness are "high"—indicates the number of farmers that should be increased.

$L_i l$—where both factor i and willingness are "low"—indicates the number of farmers who are practical targets for

Table 1. Cross table of factor *i* by farmers' willingness

		Degree of farmers' willingness	
		High (*h*)	Low (*l*)
Degree of factor *i* that influences farmers' willingness	High (H_i)	H_ih: Number of farmers that should be increased.	H_il: Number of farmers whose willingness is not expected to increase even after factor *i* is encouraged.
	Low (L_i)	L_ih: Number of farmers who cannot be the target of encouraging factor *i* because the degree of their willingness is already high.	L_il: Number of farmers who are practical targets for encouraging factor *i*.



Note 1: In the above table, a positive correlation between factor *i* and willingness is assumed.
Note 2: Maximum effective number of target persons = $L_il \times H_ih / H_i$

encouraging factor *i*.

$H_i l$—where willingness is "low" despite factor *i* being "high"—indicates the number of farmers whose willingness is not expected to increase, even after factor *i* is encouraged, because other factors are behind an initially "low" willingness.

Finally, L_ih—where willingness is "high" despite factor *i* being "low"—indicates the number of farmers who cannot be the target of encouraging factor *i* because the degree of their willingness is already "high".

Based on the above, if we designate the product of $L_i l$ and H_ih / H_i as a new indicator, "maximum effective number of target persons", the factor with the highest indicator should be most effective in further encouraging farmer's willingness to engage in maintenance activities.

This conclusion is based on the logic that, where the number of farmers who responded "high" increased across factors 1-7 because of encouraging factor *i*, the number of farmers whose willingness to perform maintenance increased by $L_i l \times H_ih / H_i$ for each factor. This calculation assumes that the ratio of farmers whose willingness becomes "high" remains unchanged from the ratio of "the number of farmers whose willingness is high" among "the number of farmers whose degree of factor *i* is high" in the status quo.

Significance of the papers

Previous research on PIM focused on standard methods used to establish a water users' organization (e.g. Groenfeldt et al. 1999, Vermillion & Sagardoy 1999), and on enhancing the capacity of farmers belonging to the organization (e.g. Memon et al. 2001, Thiruchelvam 2010). In contrast, the papers discussed in this study are valuable because they focused on the willingness of farmers to engage in maintenance activities and practically showed a method to increase willingness throughout the organization.

Moreover, these papers present a practical method and a new perspective for an efficient way to increase the willingness of farmers; first by choosing factors with a new indicator, "maximum effective number of target persons", and then working on details for encouragement of the chosen factors by adding an incentive perspective with "no decrease in vested benefits".

Future perspectives

The series of papers mentioned above showed a method for first choosing and then encouraging factors that increase the willingness of farmers, using a new indicator to enhance the performance of maintenance activities and improve PIM sustainability. Conversely, to simplify the questions when selecting the encouraging factors, we disregarded certain conditions such as the time and cost required for encouragement, and the difficulties and success rate of the encouragement. The first priority is therefore to clarify the content of incentives based on factors that should be encouraged.

Next in our papers, we focused on the willingness of farmers to engage in maintenance activities. However, the action of maintenance activities is affected not only by willingness but also "the ability to engage in maintenance activities", "the methods used to engage in maintenance activities" and "the methods used to assign maintenance activities". In addition, maintenance includes not only "the performance of maintenance activities" but also "bearing the costs of maintenance". Furthermore, OMM includes "operation of facilities" and "management of the organization and finances" as well as "maintenance of facilities". The findings of these papers thus cover only the most fundamental factors

associated with PIM sustainability.

Therefore, to effectively and efficiently improve PIM sustainability, there is a need to first analyze "factors other than willingness" that influence the inclination to engage in maintenance activities, and other factors. Furthermore, although we have analyzed the present situation of MWMS and clarified it as a successful example, it may be useful to analyze and compare unsuccessful cases to better clarify the factors associated with sustainability.

Conclusion

An efficient method for increasing the willingness of farmers involves first choosing factors to be encouraged, which should be done using a new indicator - the "maximum effective number of target persons", from seven factors influencing willingness, including awareness of the benefits of irrigation facilities. Subsequently, it is important to focus on details for encouragement of chosen factors by adding an incentive perspective that does not lead to any decrease in vested benefits. Using the above mentioned methods, farmers are expected in future to engage in continuous participation to maintain canals, resulting in improved PIM sustainability.

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