On-farm irrigation development and management in lower Myanmar: factors for sustainable rice production and collective action

On-farm Irrigation Development and Management in Lower Myanmar
-Factors for Sustainable Rice Production and Collective Action-

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Abstract

The case study is aimed at assessing impacts of on-farm level irrigation development and management on dry season rice production in the main irrigated rice production area of Myanmar. The study was carried out from 2003 to 2009 in the middle reaches of the Ngameoeyeik irrigation area of 28,000 ha. In addition to collecting information on water management and institutional arrangement of the study area, hydrological and agronomic parameters were monitored during the study period

Results showed the effectiveness of on-farm level infrastructural development for increasing rice productivity owing to increased amount of water delivery, increased flexibility of water distribution, and improved drainage conditions. Besides, encouraging the involvement of farmers in design and implementation of the development led to improved farmer participation in the operation and maintenance of the irrigation system. The outcomes of this study demonstrated the importance of balancing between infrastructural and institutional development in irrigation systems of Southeast Asia. Such infrastructural development should be in close association with institutional development and capacity building, and the interactions between those two aspects should be well understood.

Keywords:
Paddy rice production, Irrigation development, Participatory water management, Myanmar

Introduction

Agricultural sectors in a number of Asian countries still have the center role in improving their rural economies. It is particularly important to increase and stabilize agricultural production by improving irrigation and drainage systems and management (Taniyama, 2009). Many countries have emphasized the need to adopt participatory irrigation management (PIM) with the formation of farmer/water user organizations that may be combined with the development of affordable and sustainable infrastructures suited to local situations. Outcomes of this effort are mixed, some are successful but there seems to be more cases of failure.

There was a general consensus that large public irrigation systems in South and Southeast Asia had not lived up to expectations with the main issues being institutions and design (Barker and Molle 2004). Public irrigation systems had grown faster than the institutions that were needed to regulate them, while governments had tried to build irrigation from the top down approach. Bureaucracies with little accountability to farmers and no incentive to improve management were empowered with the mode and timing of water distribution (Barker and Molle 2004). Therefore, the norms of cooperative behavior, community organization, and sense of community ownership that accompanied successful communal irrigation systems had difficulties in evolving.

Myanmar is a country in Asia that relies its economy heavily on the agricultural sector. It accounted for 32% of the country's GDP in 2009-2010: 17.5% of total export earnings and employs 61% of the labor force (Department of Agricultural Planning 2011). The Myanmar government's goal is to promote increased production of paddy rice as it is the most important agricultural product to ensure food security and to generate export revenues (Fujita and Okamoto 2000). For paddy, the primary input besides land, is water. In Myanmar, 90% of harnessed water is used for agriculture.

A key priority within the agricultural water sector is the more efficient use of water through on-farm improvement and water management training (Groenfeldt 2006). Myanmar's rice production has steadily increased, especially after the introduction of high yielding varieties (HYVs) in the late 1970s. The development of irrigation infrastructure encouraging dry season irrigated rice production started in the early 1990s. Additionally, the Ministry of Agriculture and Irrigation implemented 217 irrigation projects during 1988 and 2008 (Myo Zaw Zaw 2010). Consequently, irrigated area in Myanmar increased from 1.00 million ha in 1987-1988 to 2.33 million ha in 2009-2010, and the average rice yield increased from 3.06 t/ha in 1996-1997 to 4.06 t/ha in 2009-2010 (Department of Agricultural Planning 2011), which is close to Asia's average rice yield. However, large local variations in yields have been recognized.

Increasing productivity in irrigated agriculture can be achieved when both hard (e.g. infrastructure) and soft (e.g. institution, farmer organization) aspects are in place but normally the former governs the latter (Hirashima 1984) at the early stage of development. For example, Sawada and Shinkai (2005) showed the relevance of poverty to the level of irrigation infrastructural development. On the other hand, many past studies in irrigation management have not explicitly tried to identify infrastructural circumstances that utilize the capacity of farmers and institutional arrangements, especially at the on-farm level.

Based on the case study conducted in collaboration with the Irrigation Technology Center (ITC) of the Irrigation Department (ID) of Myanmar, the objectives of this paper are to: 1) identify situations and constraints of irrigation management in the rice production area of Myanmar; 2) identify and quantify how on-farm level infrastructural development affects rice production in the case of lower Myanmar; and 3) describe how farmers coped with the given infrastructural settings to improve production. While part of the outcomes of this study have already been reported in several publications (Matsuno and Horino 2007, Horino et al. 2007, Matsuno and Horino 2009), this paper is reorganized to emphasize the important components of the study outcomes and includes additional analysis and discussions following the previous publications.

Materials and Method

Description of study area

The entire study was carried out in the dry seasons of 2003 to 2009 in the middle reaches of the Ngameoeyeik irrigation area located in the lower delta of Myanmar, which is the main rice production area of the country.

The Ngamoeyeik irrigation area extends over 28,000 ha below the Ngamoeyeik Dam constructed in 1995 (Figure 1). Double rice cropping is commonly practiced in this area in the dry season (December to May) while some farmers grow upland crops. Owing to adequate rainfall, all farmers grow rice in the wet season (June to October), while irrigation water from the system is mainly used in the dry season.

Fig.1 Ngamoeyeik irrigation area in lower Myanmar

The study area is categorized into three different levels of development:

1) Intensive Area: Applying a Japanese standard land development method, the land in this area was separately consolidated with straight water courses (WC: farm ditches) and drainage canals. Each plot is around 40a. It was developed during the implementation of the collaborative project between the Japan International Cooperation Agency (JICA) and the Myanmar government. This area is a total of 15 ha and has 9 farm households;

2) Extensive Area: This area has been developed with different WC densities to study the appropriate WC density in Myanmar. The area is 48 ha with 38 farm households, where plot-to-plot irrigation is practiced. The plots are of various sizes, with an average of around 15 a; and

3) Conventional Area; Myanmar's standard water course layout with low irrigation intensity. WCs and farm ditches are partially developed. The total area is 45 ha. The average plot size is the same as in the Extensive Area.

The study area is located along the upstream of the main irrigation canal that has a relatively stable water supply compared to the downstream area. Irrigation water in the dry season is diverted from the main canal via the secondary canal and then to WCs. The secondary canal is the so-called Direct Minor (DM) in this study. All canals are earthen open-channel with trapezoidal cross section. The bed width of the main canal is 15 m on average with the maximum water conveyance capacity of 18 m^2/s. The bed widths of secondary canals are around 1.5 m, while those of WCs are 0.3-0.6 m.

Most paddy fields are supplied with water from the WCs in the Intensive Area. In the Extensive and Conventional Areas, the paddy fields are essentially supplied with plot-to-plot irrigation, except for the paddy fields adjacent to WCs. Figure 2 shows the locations of the Intensive, Extensive, and

Conventional Areas.

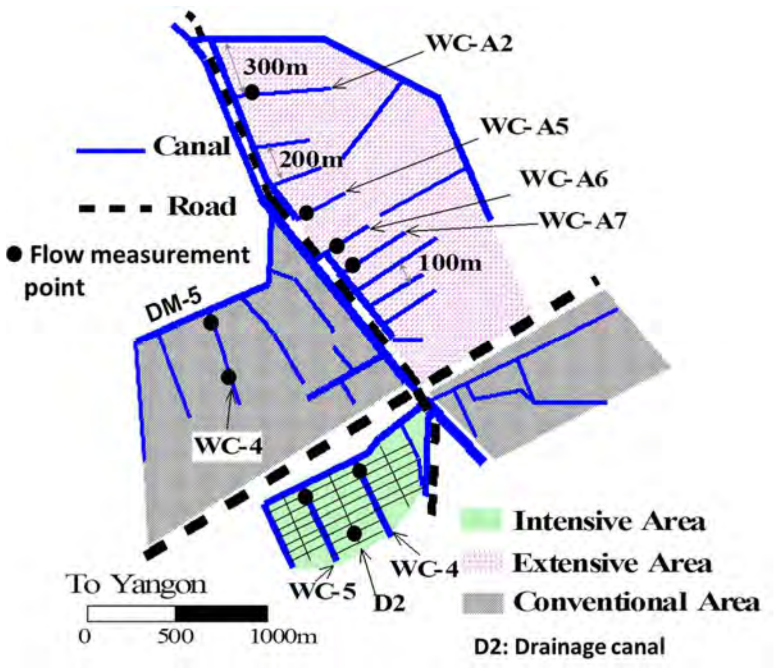


Fig 2. Schematic of the study area showing the three Areas

Field study

To quantify and compare the development status and water use efficiencies among the three areas, information on hydrology, rice productivity and socio-economy were obtained. In addition, in discussions with farmers and local government staff, the study tried to identify critical issues and feasible measures in on-farm development for sustainable water use and farm management.

The study commenced with a field survey to collect information on land ownership, land use and land elevation of the area. Other information, such as on-farm water management practices, cropping calendar, agronomical inputs and outputs were obtained from interviews with farmers in the area. The daily flow rate of the main water course of the three sub areas was observed in the dry season by installing Parshall flumes coupled with automatic water level recorders. To estimate evapotranspiration, data on meteorological parameters (e.g. precipitation, ambient temperature, and solar radiation) were obtained from weather stations nearby to the area.

Result and Discussion

Institutional setting for water distribution

Irrigation development in Myanmar started as early as the middle ninth century (Hatcho et al. 2010) during the period the Burma tribe migrated into and conquered Pyu and other tribes and established the Pagan kingdom in the middle reaches of the Irrawaddy River. Large-scale irrigation thrived with the introduction of canal irrigation systems that allowed for the large-scale and stable withdrawal of water and intensive production of rice.

Modern irrigation development of the country, similar to most Asian countries, accelerated after the 1980s. Construction, operation and maintenance of the main structures up to the secondary canal level of the irrigation schemes are the responsibility of the central government (Irrigation Department: ID, Ministry of Agriculture and Irrigation of Myanmar). The construction and management of the tertiary or WC canal and its lower levels are the responsibility of the farmers.

In the study area, the infrastructural development of tertiary and lower level canals is planned, designed, and then implemented by ID with labor contributed by beneficial farmers. However, this arrangement for development is not the same for most irrigated areas of the country, and, in many cases, farmers are fully responsible for the development of the on-farm level infrastructures.

In the Ngamoeyeik area, only rain-fed paddy rice cultivation was practiced in the rainy season before the Ngamoeyeik Dam came into operation in 1995. Therefore, it has a relatively short history of farmers cultivating dry season irrigated paddy rice. Farmers in the study area still do not have sufficient experience in collectively maintaining and managing WCs and the organization for irrigation is still in the developmental stage.

Collective water users' organizations based on individual WCs have been recently developed, particularly in Upper Myanmar in mostly arid and semi-arid areas (Myo Zaw Zaw 2010). Similarly, in the Ngamoeyeik area Water Users' Associations (WUA), such as those illustrated in Figure 3, are considered as the basic unit of the farmers' organization. Groups of farmers, referred to as Water Users' Group (WUG), are in charge of irrigating their paddy fields from a single WC. The leaders of these groups are locally called "Myaung Gaung," meaning water course head. Generally, WCs are equivalent to tertiary canals, and the canals above these are Branch Canals (secondary canals: called as Direct Minor in the study area) that are diverted from the Main Canal (primary canal). Normally, WUAs are formed in units of these Branch Canals, and their leader is often the Myaung Gaung of one of the WUGs among the WUA.

Myaung Gaungs are not government employees. Their status allows them to be exempt from mandatory labor service for the maintenance of WCs and to receive priority water supply, among other privileges. The main role of a Myaung Gaung is to oversee the repair, cleaning and other required work for the O&M of WCs, and, should a problem arise, report same to the ID's canal inspector.

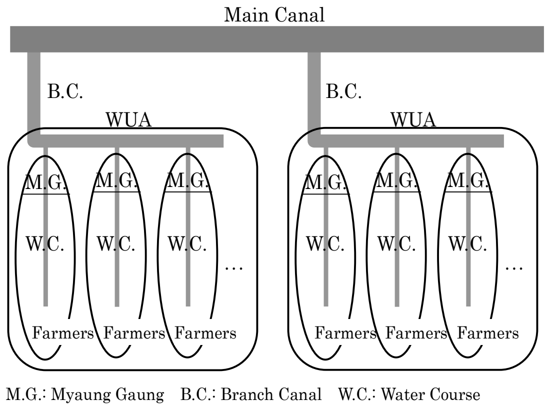


Fig. 3 Organizational structure of irrigation management in Myanmar
(Source: Matsuno and Horino 2007)

Despite these institutional arrangements, no substantial activities by the WUAs have been observed in the Conventional Area in the past. Water diversion from the main canal to the secondary canals (DM-5 in the case of the Conventional Area) is carried out by the gate operators from the ID Maintenance Office, and farmers are not involved in this operation. For DM-5, the gate operation is not conducted frequently and is virtually left open at a fixed level. The main task of the gate operator is therefore to make regular visits for inspection.

At the irrigation system level, Water Distribution Committees (WDCs) were established to organize and be responsible for supplying irrigation water (on the water allocation management side). The WDC in the Ngamoeyeik area is chaired by the Chairman of the Township Peace and Development Council (Township chairman: TC), and consists of representatives from the Myanmar Agricultural Service (MAS), the Settlement and Land Records Department (SLRD), the Agricultural Mechanization Department (AMD), and ID engineers. Of the three townships in the Ngamoeyeik area, Hlegu Township has the largest population, and its chairman is also the Chairman of the WDC.

Water allocation Rule

Although the WDC of the study area does not have a long history and is still at the developmental stage, it functions as the decision making body for most water allocation plans that target the paddy fields that have not started dry-season rice cultivation. Figure 4 illustrates the general procedure followed by the water allocation plan. Firstly, each government divisional office inquires from the WDC about the allocation plans for the area to be planted during the relevant period. The

WDC in response considers the usable amount of water (the amount of available water resources) and the condition of the land (location, elevation, etc.), and then replies to the government on the areas that could be irrigated. If the government approves the plan, the amount of water to be allocated is decided on in accordance with the area to be benefited. The result of the decision is then passed on from the WDC to the VCs (village track chairmen) and from the VCs to the 100 HLs (100-household leaders: The 100 HL is a representative of the group that consists of about 100 households and is similar to a mutual support group). Each 100 HL then informs the farmers, who are also members of WUA, in his/her jurisdiction of the results. The request from the WDC is not always approved by the government at once and several adjustments are normally required between the WDC and the government.

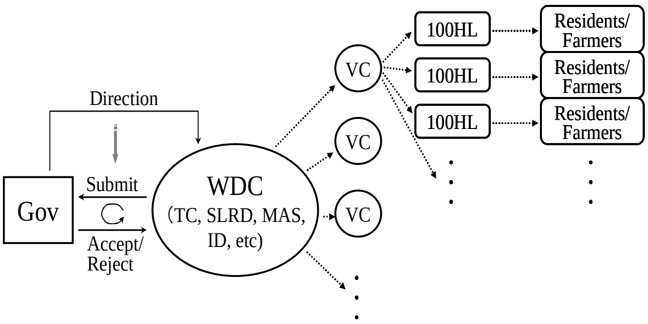


Fig. 4 Schematic of the decision making process for water allocation
(Source: Matsuno and Horino 2007)

Rice production and physical constrain in the study area

The data and information obtained during the study confirmed distinguished differences among the three sub-areas as follows: Intensive area had a relatively high rice yield (average of 4.3 t/ha) with appropriate availability of irrigation water and sufficient drainage conditions; the Extensive area had a low yield (average of 2.0 t/ha) due to poor drainage, mainly caused by the undulation of plots; and the Conventional also had low yields, the same yield level as in the Extensive area due to severe water scarcity and micro-topography.

The Intensive area has an ease of water control owing to the straight alignment of irrigation (WC) and drainage canals along with land leveling that allows for water to be distributed to each plot directly from the water courses. On the other hand, even without a shortage of water, the Extensive area has problems in water distribution and drainage due to insufficient canal alignments and gradients that do not correspond to plot elevations. The Conventional area has a similar problem in micro-topography, in addition to a restriction of intake to the water course. Owing to these physical conditions in the Extensive and Conventional areas, the water courses do not function properly and farmers have to rely heavily on plot-to-plot irrigation. As such, farmers are unable to distribute water to tail end plots efficiently even though sufficient water is available at the intakes of water courses.

Regarding the water intakes, the Intensive and Extensive areas have approximately 10mm/day available for distribution to water course. In this area, the estimated daily ET was 4.5 mm/day on average and deep percolation was 1.0-1.5mm/day (clayey soil). Therefore, from a water balance perspective, these two sub-areas do not have a water shortage. On the other hand, the Conventional area's water availability to the water course was 4.5 mm/day on average in the 2003-2004 and 2004-2005 dry seasons. This result implies that the Conventional area may be facing water scarcity. Because of the water shortage and undulated plot formations, the irrigated area of the Conventional area is limited to the adjacent water course.

In summary, from the analyses of hydrological data, ground elevation and WC alignment, and the results of farmers' questionnaires, the present status of each area is shown in Table 1.

Table 1 Summary of study area characteristics in 2003-2004 and 2004-2005 dry seasons

Area	**Infrastructural development level**	**Average rice yield (std)**	**Notable situation**	**Monitored water course and beneficially**
Intensive	High (Land consolidated: Land leveled, separation of irrigation and drainage canals)	High: 4.32 t/ha (0.77)	Sufficient water supply	WC-4 and WC-5
Extensive	Moderate (Increased canal densities)	Low: 2.22 t/ha (0.28)	Poor drainage, land elevation problem	WC-A2, WC-A5, and WC-A7
Conventional (DM-5)	Ordinal (Traditional style of development)	Low: 1.92 t/ha (0.68)	Problem in water delivery	WC-4

Factors affecting rice yield in dry season

The previous section described the physical limitations of the Extensive and Conventional areas that might be significantly affecting the rice productivity in the irrigated agriculture of the area. Obviously, there also are other agronomical factors affecting the yield. In order to quantify the significance of such factors, a multiple regression analysis was carried out. For the analysis, the level of infrastructural development (e.g. Conventional, Extensive, and Intensive), the amount of fertilizer applied, and rice varieties are considered as independent variables, and rice yield was set as the dependent variable. The other potential factors, such as metrological conditions, soil, labor input, and pesticide application did not differ among the three sub-areas and they were not considered for the dependent variables. The categorical regression analysis with the optimum scaling method was applied using data from the 2003-2004 and 2004-2005 dry seasons. The result is shown Table 2.

Table 2 Results of categorical regression analysis on effect of infrastructural development, fertilizer input, and variety on rice yield [1)]

Independent Variable	Range	Coefficient of standardization	Level of Importance [2)]
Infrastructural development level	1~3 [3)]	0.865** [4)]	0.879
Fertilizer input	70~490 kg/ha [5)]	0.174* [4)]	0.105
Rice variety	1~8 [6)]	0.288**	0.016
R^2		0.836**	

Note :
1) Source : Matsuno and Horino (2009)
2) Calculated by the equation : (Coefficient of standardization*Zero-order correlation)÷Coefficient of determination.
3) 1. Conventional area, 2. Extensive area, 3. Intenisve area.
4) Significant at 1%(**) and 5% (*).
5) The optimized scaling method was used to categolize the fertilizer input level.
6) The farmers in the study area used 8 types of nonphotosensitive highyield variety for dry season rice cultivation.

The result shows that all the independent variables are significantly correlated with the yield. Among them, the land development level is identified as the most important factor. This implies that the impact of agronomical improvement, such as increasing fertilizer application and using the high yield variety on the field, is minimal without improving the physical condition of irrigation and drainage.

Collective Action for irrigated rice production

Prior to the 2005-2006 dry season, the study team organized a total of four workshops with the participation of all farmers (expect one workshop with absence of few farmers) of the Conventional area to report its findings and discuss possibilities of improving water management for rice production in the area. A plan of action was aimed at increasing rice production by increasing the amount and flexibility of water intake to the water course for ease of water control and delivery to the fields. Through this process it was also intended to reach common understanding among farmers on the current constraints and increase awareness on participatory operation and maintenance for water management.

The farmers in the Conventional Area in WC-4 perceived that water scarcity was the most critical issue for rice production as expected and were very positive about taking collective measures of action. It was also confirmed and stated to all relevant farmers that, owing to the problem of farm-plot elevation, water allocation would be impossible to some lands even with the change in WC alignment, and that water could not be allocated to the entire area owing to limited available water. Also, in order to improve the state of water intake from the WC, it was pointed out that the intake capacity of the inlet at the secondary canal (DM-5) needed to be rehabilitated as the bed slope of the DM was irregular and damaged in some places.

It was obviously important to develop proper WCs. Therefore, the potential to develop a new WC alignment (WC layout), including quaternary or fourth-level canals, taking into account of the existing topography and attributes such as landholders, was assessed. After discussion with farmers, it was decided to adopt the following for the Conventional Area based on the general consensus of the farmers: 1) the cost of rehabilitation should be low and it can be done by farmers providing labor; 2) the existing farm-plot layout will be unchanged as much as possible; 3) although it is not possible to deliver water to all farm-plots, the minimum number of plots traversed will be reduced from the present number for farm-plots where water intake is possible; and 4) the existing WCs will be rehabilitated and utilized effectively, and newly laid parts will be kept to a minimum.

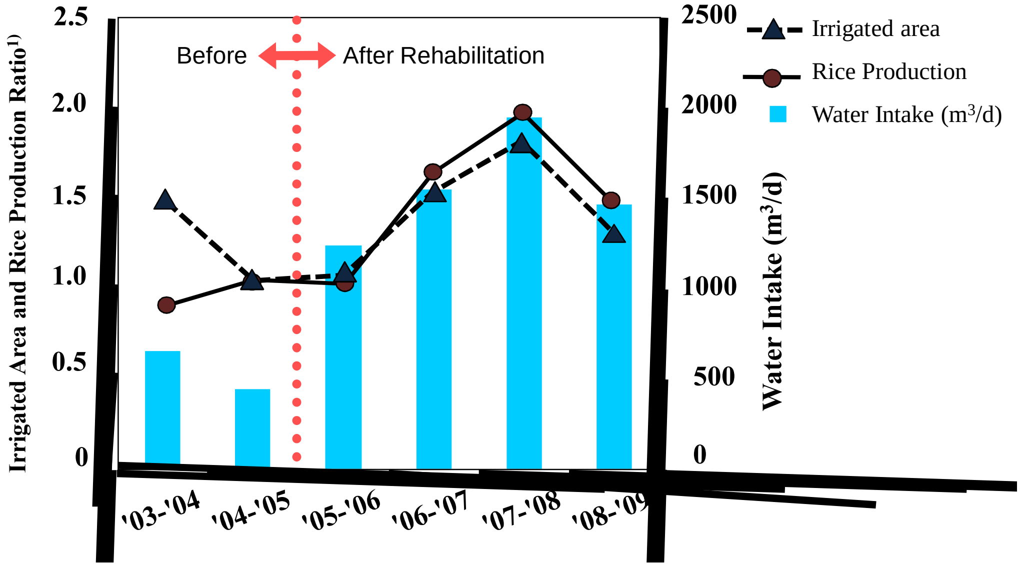
Conversely, during these workshops, it was discovered that the majority of farmers in the Extensive Area regarded the problem of poor drainage as more important than that of the WC alignment, despite the fact that water delivery was impossible to some land due to farm-plot elevation. It was therefore decided that the present alignment of the WCs should be retained.

It was also decided that the rehabilitation of WC-4 and the DM-5 should be carried out by the farmers themselves before the beginning of the 2005-06 dry season in December, with technical guidance from the ITC for WC-4 and from the Maintenance Office of the Ngamoeyeik area for DM-5. The largest change was that the inlet of WC-4 at DM-5, i.e. the upper-level secondary canal, be placed in a slightly upstream position and the alignment of WC-4 changed to have more contact with farm-plots with the WC.

Consequence of intervention

Figure 5 shows the changes in irrigated rice production area, rice production, and amount of water intake in the Conventional area from the 2003-2004 to 2008-2009 dry seasons. After the intervention, the amount of water intake increased 2.8 times, and the irrigated area increased 1.5 times, in addition to an increased rice yield of 3.0 t/ha. The increase in the irrigated area was not proportional to the increase in the water intake because the existing plots were under water shortage before the intervention. Therefore, only surplus water was used for the newly irrigated plots and some plots still face difficulty in water distribution due to land elevation even after the new alignment. Overall, most farmers felt improved reliability of water delivery and flexibility of water management with the new alignment, especially the downstream farmers who benefitted from the increased flexibility.

Consequently, the operation and maintenance activity organized by the village chairman until the 2006-2007 season, was organized by the farmers themselves from the 2007-2008 season. This implies that more commitment from farmers for water management in an organized manner was caused by the collective actions for improvement of the infrastructure, leading to a realization of the advantages of participation.



Note: 1) Values of irrigated area and rice production are relative ratios to those in the '04-'05 dry season.

Fig. 5 Changes in irrigated rice cultivation area, rice production, and amount of water intake in Conventional area from 2003-2004 to 2008- 2009 dry seasons

In addition, we found that the number of plot pathways from WC to the plot of interest can be used as an indicator for flexibility of water management (Horino et al. 2007). In principle, the number of plot pathways should be reduced when more plots can take water directly from the water course. Contrarily, the number of plot pathways should increase when the irrigated area was expanded. Therefore, our intervention should cause a set off in terms of the number of plot pathways.

In fact, only a slight decrease in the number of plot pathways was observed after the intervention which did not affect the flexibility of water management.

Direction of irrigation development and management

An early stage of irrigation development in Asia after World War II can be typified by large scale infrastructural development (Hirashima 1984). Kikuchi (2005) envisaged development paths of irrigated agriculture in monsoon Asia in three stages. The first stage was an extensive expansion phase coping with population growth and an abundance of uncultivated land. The second was the phase of increasing productivity of the cultivated land by irrigation development. The third is to further improve productivity of irrigated land by improving existing systems by rehabilitation, modernization and improving management. In many cases, these stages were overlapping at some point but shifted towards the third stage in accordance with relative costs for development. With an increasing population and a decrease in arable land area as in the first stage, the cost of land expansion would eventually become higher than the cost of irrigation development. When the second stage progresses, the cost of irrigation development would increase as the focus of development shifts to areas that require more cost to construct irrigation infrastructure with less available water. In the third stage, there is evidence that the ratio of economic return varies in irrigated areas because at this stage farmer participation in the project is an important factor for success, but it often failed (Kikuchi, 2005). To ensure sustainable management and operation of water control systems, understanding the need for a solid foundation with local participation and management organization is essential (Hatcho, Ochi, and Matsuno, 2010). In applying this ‘‘stage theory’’, the present situation of Myanmar is considered to be at the transition stage, currently somewhere in between the late second and third stages. On the other hand, the emphasis is currently on the development of main hydrological infrastructures such as dams and main canals, and sufficient resources are not committed to on-farm level development.

Based on the results of this study, there is a high possibility that introducing Japanese-style land consolidation like the method applied in the Intensive Area would contribute to an improvement in the productivity of paddy rice cultivation in Myanmar. As seen in the Mandalay area, there are some pilot areas where land consolidation with separate irrigation and drainage canals have been implemented. However, it is clear that expanding such Japanese-style land consolidation to the entire country is difficult economically and technically. Presently, it is expected that most of the areas with low productivity in the Myanmar delta area are employing similar methods as the Conventional Area. The Extensive Area, which is considered as the intermediate method between the Intensive Area and the Conventional Area, did not show a significant difference in productivity when compared to the Conventional Area. This suggests that, in order to improve productivity, in addition to making a change to the density of WCs other measures are also necessary.

In order to resolve these problems and, in particular, to expand the irrigation area and increase the productivity in the Extensive and Conventional Areas by increasing the efficiency of water use for paddy rice cultivation in the dry season, the following interventions could be considered: 1) Improve farm-plot elevation with respect to the bed slope of WCs and ground level of the plots; 2) Construct WCs adapted to the farm-plot gradient, enabling water to reach further downstream farm-plots and install field ditches wherever necessary (leave the final decision to farmers); 3) Improve drainage conditions, and make it possible for each farmer to drain water quickly whenever necessary; 4) Line WCs to reduce seepage losses (to farm-plots unsuited for cultivation) and at the same time expand the potential area of water conveyance; and 5) Enhance the institutional capacity of WUAs through information provision, training, etc., and strengthen the efficiency of water use through rotation within WCs, etc.

It is obvious that basic infrastructural developments, such as land leveling, would be essential, which was consistent with the perception of farmers as was identified in the questionnaire. A realistic response would probably be to establish provisional measures, and, in the meantime, to promote the technology for preparing new equipment and supplies for construction technology in the long run.

PIM has not been widely practiced in Myanmar, and it seems to be a long way from developing a bottom-up decision making process in the present circumstances. On the other hand, the officers of the ID and the local managers have begun to recognize the importance of participatory management that have resulted in a series of trainings and workshops conducted by the government and international organizations. In order for the participatory management to be widely accepted in the nation, the first step could be to develop the framework for a farmer-centered irrigation management system, rights and duties of farmers, etc. that are adapted to the country's economic and social circumstances.

Conclusion

This study revealed that the premise for a successful water management with farmers' participation would go hand in hand with proper irrigation infrastructures that can be managed by farmers. It was also revealed that farmers would consider maintaining the irrigation canals voluntarily when they recognize the increase in water accessibility through the improvement of irrigation facilities and its contribution to improving productivity. The government/donor may need to provide the information and technologies in a timely manner for farmers to develop irrigation facilities and its management by themselves.

The outcomes of this study emphasize the importance of balanced development between hardware and software in Southeast Asia. The infrastructural development should go along with the institutional development and capacity building, and the interactions between these two aspects should not be ignored. In this process, the government or state agency has a large role to play by supporting farmers and their organizations in capacity building to handle infrastructures in the development.

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