Policy Proposal on Water Management Systems in Terminal Canals for Paddy Fields in Indonesia – Lessons from Experiences in Asian monsoon region and Japan

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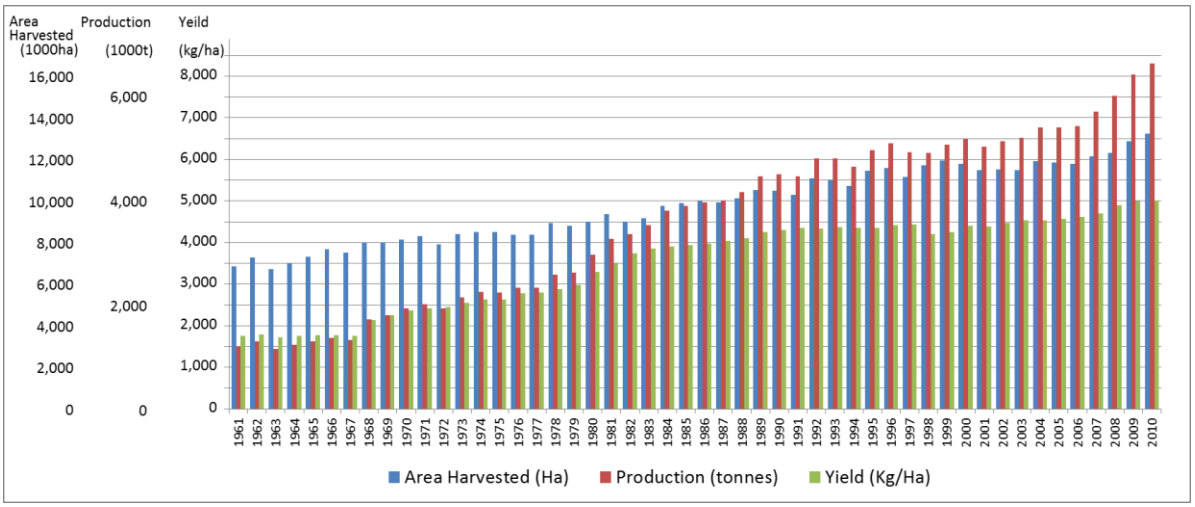
Abstract:
The paper summarizes current administrative systems which support paddy irrigation management in Indonesia and points out problems to be solved at the transitional term of policy reformation. The upshot is that the agricultural production is slow to develop as a result of low water use efficiency at the field level because of problems in establishing and managing paddy irrigation systems at the terminal canals level as well as in the process of establishing and rehabilitating main canal systems. Stabilizing food security through domestic rice production is Indonesia's national issue. Therefore, by introducing the institutions and case studies on collective water management systems at the terminal canal level in Japan and Asian monsoon countries, the paper suggests the development of technologies and institutions for water management of existing irrigation systems in Indonesia and recommends a policy framework to facilitate the establishment of an integrated water management system to promote stable food security in Indonesia.

Contents

1. Current situation and issues on rice culture in Indonesia

1.1 The present state

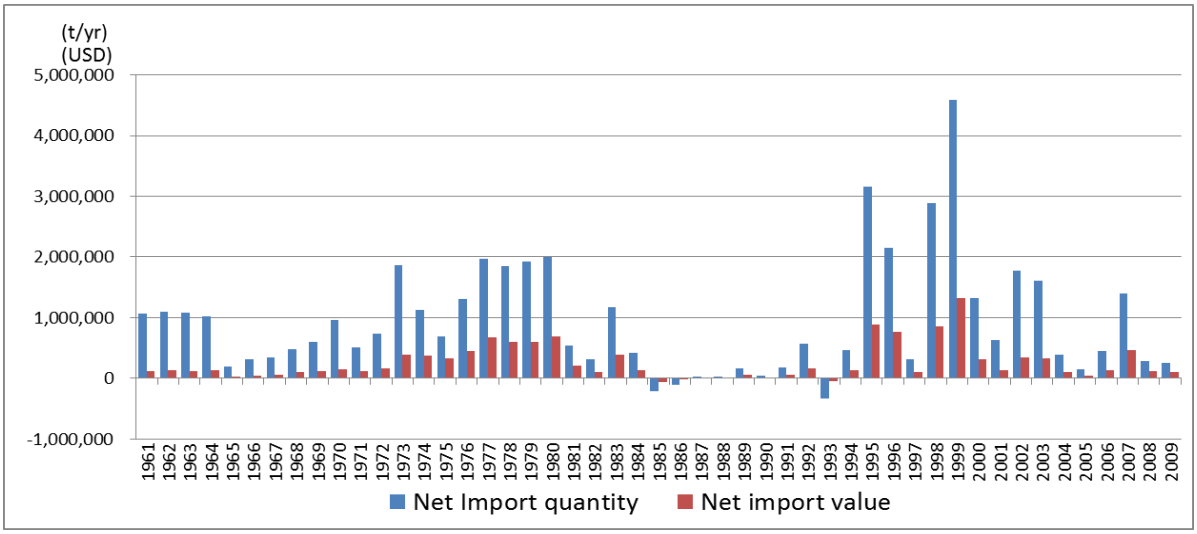
The economic sector of agriculture accounting for 16% of GDP and 38% of the national labor force in 2010 is a key industry in Indonesia to take an important part in food supply and employment creation. According to the Agricultural Statistics 2010, Ministry of Agriculture, Database of Directorate of Irrigation and *Badan Pusat Statistik*, the area of rice paddy fields totals 8,050,000 ha broken down into 5,300,000 ha for irrigated fields, 1,670,000 ha for rain-fed paddy fields and 1,080,000 ha for waterlogged lowland paddies. The total annually harvested area amounts to 12,880,000 ha; rice (paddy) production amounts 64,400,000 MT and the yield runs up to 5.0 MT/ha. The total annually harvested area reached its ceiling in 1990's to mid-2000's but has increased since 2008 when the market price of rice soared. (Fig. 1)



Source: FAOSTAT, Badan Pusat Statistik Note: Data in 2010 is the first forecast

Fig.1 Area harvested, production and yield of rice (paddy) in Indonesia (1961-2009)

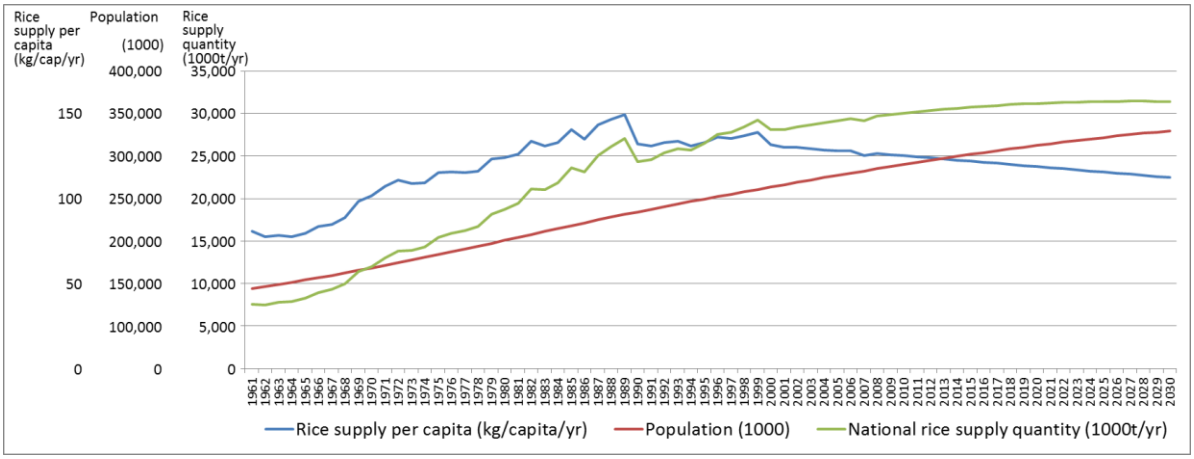
Domestic production of rice as staple food did not cover its national consumption until 1984 when its national self-sufficiency attained, but net import of rice resumed in mid-1990's and run up to 4,592,000 MT in terms of milled one because of fluctuated annual production and was valued at USD 1,326 million. Since then increase in the total domestic production resulted in decrease of the net import year by year, finally which lowered to 147,000 MT in 2005. However, external factors such as recent abnormal weather and steep rise in prices of fertilizers and chemicals after a monetary crisis, or temporary increase of distribution stocks forced the state of Indonesia to take the plunge and make emergency imports of rice amounting to 1,400,000 MT in 2007 and 1,800,000 MT in 2010, respectively. (Fig. 2)



Source: FAOSTAT

Fig.2 Net import quantity (milled equivalent) and net import value of rice in Indonesia (1961-2009)

Population in the state continues to increase by 1% annually while food supply-based consumption of rice per capita hit a peak in 1989 and gradually decreased since then; it leads to future projection for the national demand of rice as a continued gradual increase until the late 2020's. (Fig. 3)



Source: FAOSTAT Note: Datum for rice supply after 2007 are estimated by author

Fig.3 Rice supply per capita, population and national rice supply quantity of milled rice in Indonesia (1961-2030 as projection after 2007)

Moreover, according to the Directorate General of Water Resources, Ministry of Public Works, Indonesia, an annual area of irrigation land converted into other economic usage such as housing, industries, other plantation like palm trees, etc. is estimated at 40,000 ha/year.

The government of Indonesia is putting national food security as a key issue and launching policy measures for stabilizing the market price of rice. The first is emergency rice reserve amounting to 500,000 MT run by the government who manages it by releasing the whole quantity within months. The second is the RASKIN program which set up for 17,500,000 poor households in the nation as it holds 30,000,000 undernourished people equivalent to 13% of its population. The program allows the authority to procure and to provide rice whenever its price soars. According to the program, the emergency rice reserve and rice procurement from the market in 2011 are 1,700,000 MT and 3,000,000 MT, respectively. Furthermore, the nation joins in the ASEAN Plus Three Emergency Rice Reserve (APTERR) as an international food security cooperation scheme with neighboring countries. (Table 1)

Table 1 Number and percentage of undernourished people in Indonesia

Year	1996	2001	2006
Number of undernourished people (1000 inhab)	22,000	30,400	29,900
Year	1997	2002	2007
Percentage of the total population undernourished (%)	10.7	13.9	12.9

Source: AQUASTAT (FAO)

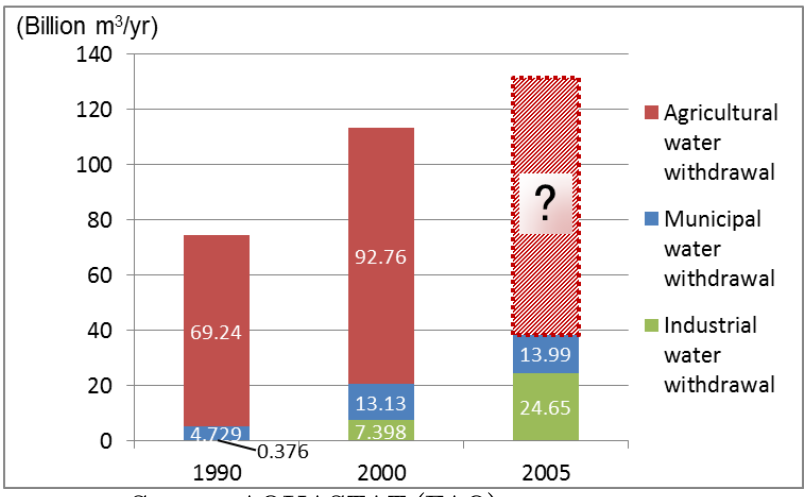
In recent years, the demand of rice in Indonesia has dynamically changed as strong demand for high-quality rice boomed with the increase of GDP per capita. Increase in the demand for quality rice has led to the increase in the gaps between demand and supply resulting in the surge upward of market prices. So not only securing the amount of rice production but also the production of quality rice, is strongly required in accordance with the change in the nature of the demand in Indonesia in the future.

1.2 The issues

Therefore, the government of Indonesia launched the Mid-term National Development Plan (2010-2014) as a Presidential Order in which it sets an objective for attaining stable national food self-sufficiency by 2014 and aims at the increase of rice production by 12,000,000 MT. The Ministry of Public Works has been mandated in the plan to develop and expand 500,000ha of new irrigation areas and to repair existing irrigation facilities for 1,340,000 ha of beneficial farmland. Local governments such as provinces and districts are also directed to operate and maintain existing irrigation facilities for 7,230,000 ha of farmlands and repair them for 2,680,000 ha in total for 5 years. Further it is urgently necessary for these authorities to modernize decrepit

irrigation facilities which had been operating for over 30 years.

The status of water resources in Indonesia is described as 2,702 mm of average annual precipitation in depth, 5,146 billion m^3 of average annual precipitation in volume and 2,019 billion m^3 of total renewable water resources. The volume of annual water withdrawal in 2000 was 92.7 billion m^3 for agricultural water use, 13.1 billion m^3 for municipal water use and 7.4 billion m^3 for industrial water use. However, FAO estimates that the volume of industrial water withdrawal must have reached 24.7 billion m^3 in 2005, three times as much as that in 2000. The state need some 10 billion m^3 of new water resources development for agricultural sector alone to accomplish 500,000 ha of new irrigation development based on the Mid-term National Development Plan. It is necessary not only to invest in infrastructures, but also to improve the precision of water management for existing irrigation facilities in order to cope with the abovementioned steep increase of water demand. (Fig. 4)



Source: AQUASTAT (FAO)
Note: Figures in 2005 are estimated by FAO

Fig.4 Annual water withdrawal by sector in Indonesia

The amendment of the Water Resources Law in 2004 has allowed a new system of water management for irrigation in Indonesia. It has regulated since then that farmers should be responsible for the operation, maintenance and slight repair of terminal irrigation facilities equipped in the tertiary canals and after them, and water use associations organized by farmers are designated as the proper authorities to implement them. (Table 2)

The system of charging water fee to farmers as the financial base of water users association has already been introduced since 1987. However, farmers' motivation for a systematic water management was undermined because there are so many damaged and overage irrigation systems in which fair water distribution is not being

realized due to functional deterioration. It has built a vicious spiral of advancing functional deterioration and suspended proper operation and maintenance for more irrigation facilities.

Table 2 Allotment of roles of management bodies for irrigation development and operation and maintenance in Indonesia

Management bodies		Development	Operation and maintenance
Central government		Facilities with irrigation command area exceeding 3,000ha and extending beyond the provincial borders	Facilities with irrigation command area exceeding 3,000ha
Local government	Provinces	Facilities with irrigation command area extending from 1,000ha to 3,000ha and beyond the border of districts	Facilities with irrigation command area extending from 1,000ha to 3,000ha
	Districts	Facilities with irrigation command area extending less than 1,000ha and within a district	Facilities with irrigation command area extending less than 1,000ha
Water users association		Development and operation and maintenance for facilities in tertiary or after tertiary canal systems	

If one wants to stop such a vicious spiral and to maintain better functioning of the irrigation systems for improved irrigation efficiency, one has to achieve, first of all fair water distribution from the main source to the end terminals of the irrigation systems. The policy principle of farmers' participatory irrigation management is "To require farmers' participation in all activities within irrigation management, in every step from decision-making to implementation" as provided for in the Water Resources Law amended in 2002. It implies that farmers' participation depends on their sustainable motivation. Moreover, the governmental bylaws enacted in 2006 provided farmers' participation as follows;

a) Farmers' acquisition of water right in their individual or collective capacity regardless of permission.
b) Farmers' participation in the development of irrigation systems or their self-help development by themselves according to necessity and capacity
c) Farmers' contribution to drawing up of irrigation management plans
d) Farmers' participation in the implementing operation and maintenance
e) Administrative authorities' implementation to education, training, research development and support in order to strengthen farmers' activities on planning, implementation, monitoring and management.
f) Farmers' monitoring in implementing participatory irrigation management
g) Farmers' construction, managing and maintenance of tertiary canals

In addition, it is certainly important for the administrative authorities

supervising terminal irrigation systems such as tertiary canals and after them to establish model project areas nationwide in which they systematically build irrigation facilities as well as operation and maintenance systems to demonstrate the feasibility of fair water distribution from the head of the tertiary canals to the end of terminals at the paddy field level of the irrigation systems. They can develop advanced water users associations in these model areas and demonstrate the reality of fair water distribution up to the terminals to spread it to other water users associations nationwide through their field visit and training.

2. Institutions and distinctive features of the irrigation project in Japan

2.1 The principle and institutional features of the irrigation project

Almost all the government-support irrigation projects in Japan have been executed under the systems of the Land Improvement Act which came into force in 1949. This Act enabled tenant farmers to become official applicants of irrigation projects and land consolidation projects while the conventional laws had allowed only land owners. Under the conventional systems, Water Users Association Act enacted in 1899 and related regulations, land consolidation projects, in contrast to irrigation projects, were unpopular with the so-called parasitic land owners who had no interest in improving labor productivity on the fields.

The Land Improvement Act, in conjunction with drastic agricultural land reforms from 1947 to 1950, helped the emancipated farmers to collectively set up land improvement projects, i.e. irrigation projects for main and lateral canals and some of the smaller sub-lateral (tertiary) canals and land readjustment project for the enlargement of farmland lots. The epoch-making policy was the establishment of the comprehensive land consolidation project which had been institutionalized since 1963 as a reaction to the Agricultural Basic Law enacted in 1961, which has enabled the farmers to construct systematic sub-lateral (tertiary) canals and ditches with land readjustment and enlargement simultaneously. Since then, the consistent construction and management of total irrigation systems from main facilities such as dams and head works to terminal ones in paddy fields level have been successfully realized in Japan.

The Land Improvement Act provides that an irrigation and drainage project should be implemented by the proper project management body in accordance with the beneficiary area of the project and the degree of technical difficulty. There are i) national projects implemented by the Ministry of Agriculture, Forestry and Fisheries (MAFF), ii) prefectural projects implemented by prefectural governments, and iii) communal projects implemented by municipalities or Land Improvement Districts (LIDs). (Fig. 5)

The important features of the procedures provided by the Land Improvement Act for implementing irrigation projects are as follows;

a) Implementation based on farmers' own initiative (application) and corresponding share of expenses for project

Though an irrigation project is a public investment for the formation of a social infrastructure in rural areas, the Land Improvement Act requires farmers to share a part of expenses for the project as they are direct beneficiaries of that and stipulates in principle that 15 cultivators or more should initially apply on

their own initiative.

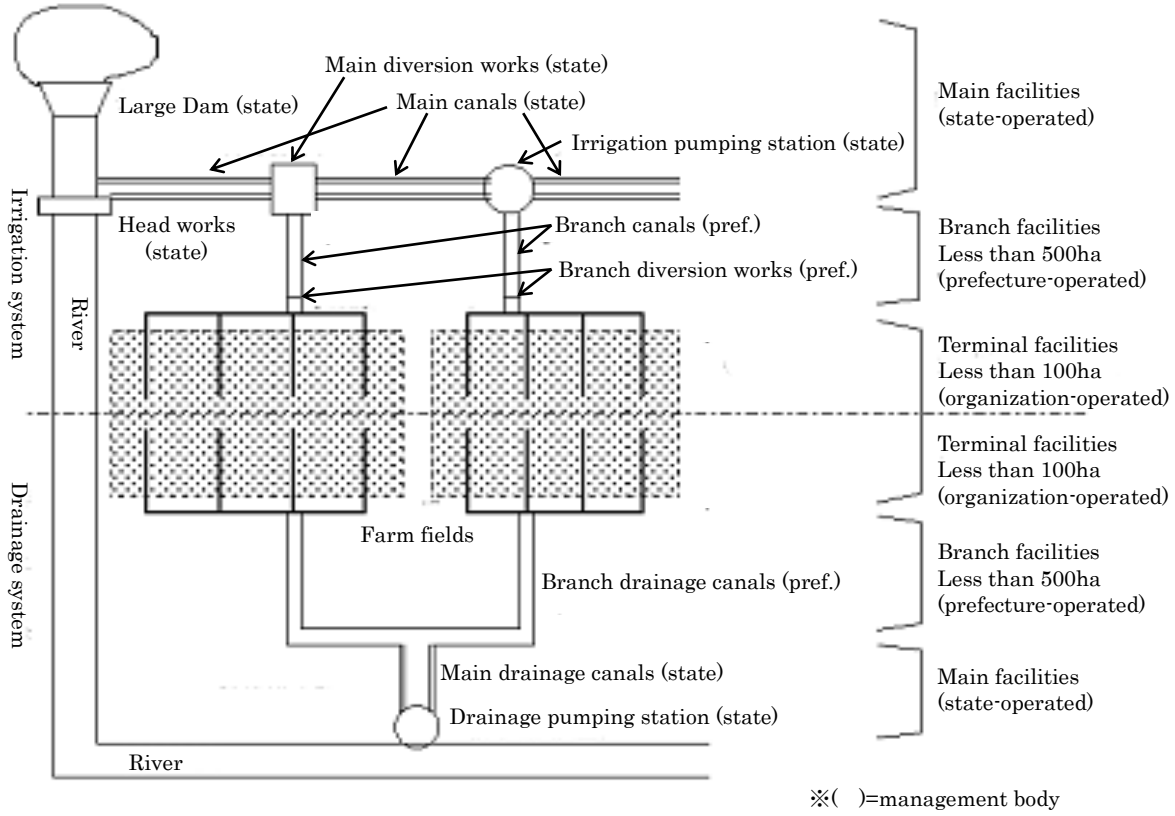


Fig.5 Facilities constructed by each project management body under the Land Improvement Law of Japan

b) Implementation based on beneficiary farmers' consent and obligatory participation/cost sharing for the project

The Land Improvement Act requires obligatory participation and cost sharing to all farmers within the project's settled beneficiary area if more than two thirds of them consent to the project because it is necessary for them to include certain contiguous areas in which lands and water ways are connected.

c) Establishment of water users' association namely LIDs to be responsible for the irrigation management after completion of the project

The Land Improvement Act requires that facilities constructed through irrigation projects in principle should be managed spontaneously at their own expense by LIDs to be established by farmers using the facilities. It is because the management of irrigation facilities aims not only to maintain and manage the efficient function of facilities, but also to distribute water to beneficiary areas effectively through the services and operation of facilities and it is deemed extremely important to distribute water fairly to all farmers in the

assigned beneficiary area. Therefore the LID organized by beneficiary farmers carries out all of the planning, implementation, dispute settlements, assessments and collection of fees for water distribution.

The outline of operation and maintenance systems for irrigation and drainage projects by the distinguished project management bodies is as follows (Fig. 6);

a) Facilities constructed under national projects

Following the completion of a national project, the national government can entrust the management of the facility to the LID, municipality or prefectural government (with the national government retaining possession of the proprietary rights) or transfer the facility to them (including proprietary rights). The national government can also manage the facility under its direct control when beneficiary farmers apply to the government.

b) Facilities constructed under prefectural projects

Following the completion of a prefectural project, the prefectural government can entrust the management of the facility to the LID or municipality (with the prefectural government retaining possession of the proprietary rights) or transfer the facility to them (including proprietary rights). The prefectural government can also manage the facility under its direct control when beneficiary farmers apply to the government.

c) Facilities constructed under communal projects

In principle, the communal project management body takes care of the management.

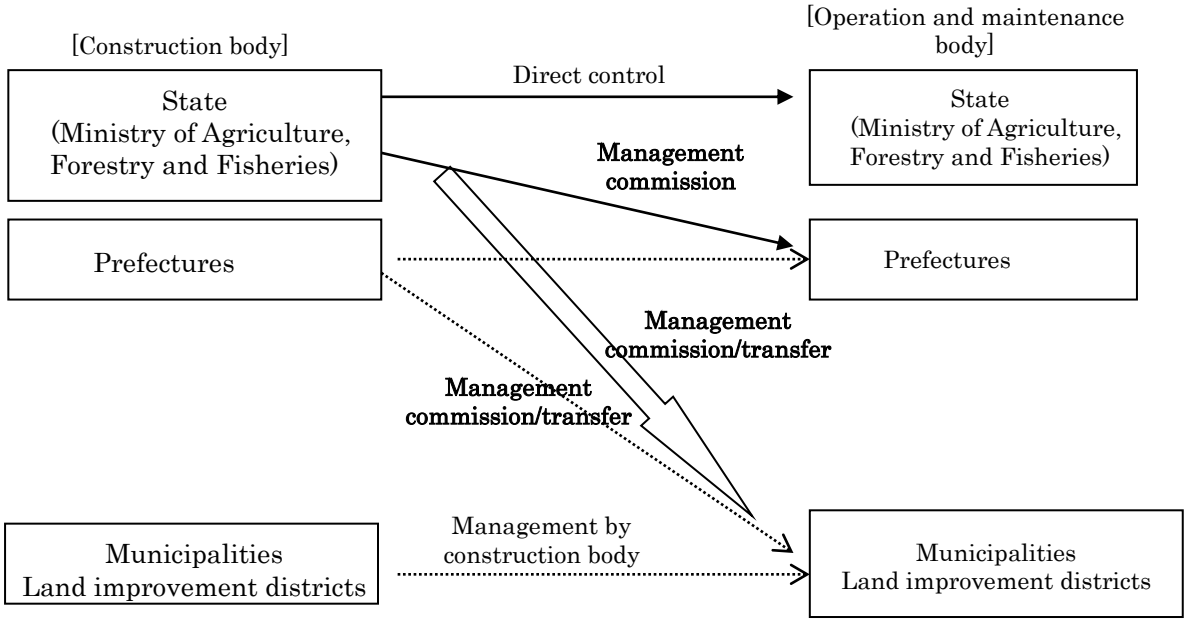


Fig.6 Relationship between construction bodies and operation and maintenance organizations for irrigation facilities under the Land Improvement Law of Japan

2.2 Advanced features and effects of irrigation projects compared to other general public works projects

In this way, requirements stipulated by Japan's Land Improvement Act implementing the irrigation projects are: (a) A project must involve at least fifteen cultivators of agricultural land owners and tenant farmers, (b) A certain beneficiary area should be fixed and the project must be agreed upon by at least two thirds of the people in the area that will be benefited by the project, and (c) The beneficiary farmers in the project area must establish a Land Improvement District that is responsible for the operation and maintenance of irrigation facilities and the management of water distribution services. It suggests that these indicators work in three stages, verifying that the project has conditions suitable for building governance, i.e. the cooperative management of public space, between governments (central and local) who are owners of the main project and the beneficiaries in the project area.

To specifically explain the distinctive aspect of this Land Improvement Act system, the Act provides a mechanism that initially verifies the accumulated level of social capital, i.e. a social platform consisting of mutual trust, norms and networks, as a necessary condition in maintaining collaborative actions such as the sound implementation of participatory irrigation management, in order to facilitate the achievement of land improvement policy objectives, which includes among others the improvement of agricultural productivity in harmony with the environment and sustainable development of rural areas. Moreover, this is a project implementation procedure based on the Land Improvement Act, in which substantive enactments were publicised as an institutionalised system where the requirements are clearly set out by the Japanese government prior to the approval of each land improvement project, ensuring the consistency of the system, without any exception, in implementing government-support projects continuously and throughout the country.

As described above, although land improvement projects are one of the major public works projects in Japan, the Land Improvement Act has always made it clear, since its promulgation in 1949, that the obligatory participation and involvement of the non-government sector in projects are institutionalised, thus ensuring that potential government failure caused by the government's absolute control is diminished, while establishing a system whereby policy objectives are achieved more effectively and efficiently and the promotion of democratic values and public interests is maximised. Land improvement projects have already been implemented for more than half a century since just after the Second World War, and they have attained many notable achievements. It is correct to say that when comparing these with other general public works projects, which are led by the public sector in a monopolistic fashion, the irrigation projects under the Land Improvement Act have two superior and significant effects by verifying at a local level that the accumulated level of social

capital exceeds the required criteria prior to project implementation and by proceeding with a project in conjunction with the building of the beneficiary farmers' governance.

Firstly, the irrigation projects can realise more effective achievement of policies of this government-support project in each target area, thus ensuring an increase in the cost-efficiency of the national budget that is spent on such projects. For example, as water users who benefit from a project must bear a part of the project cost, government engineering officials have direct accountability to the beneficiaries to fully inform them of the function and design data of facilities provided in their area by the project, as well as how the budget is spent on the project. This means that a moderate tension exists between project beneficiaries and authorities. Public works projects generally create tension between the government and parliament or tax payers but land improvement projects add more direct, tense relationships with project beneficiaries from a different perspective. Moreover, with regard to the purchase of a lot on a site designated for the project, the land owner is often a project beneficiary, or someone who is close to the beneficiary. This facilitates smooth cooperation and enables the saving of transaction costs on negotiations and site acquisition.

Secondly, land improvement projects contribute greatly, beyond each target area, to national land conservation and social stability by facilitating the sustainable accumulation of social capital, at least up to the minimum level nationwide. Most especially, during the period of rapid economic growth in the 1960s and 1970s, urban-rural income disparity widened and the rural workforce, especially the young generation, continued to pour into the cities. Under these circumstances the effect of maintaining land and water resources conservation and social stability in rural regions by the local communities, accompanied by the forming of governance between them and the public sector, was significant. Furthermore, during an economic slump, it is possible for many labourers in cities, who periodically return to their rural hometowns, to feel reassured by their local background. Those effects were becoming more significant because land improvement projects were implemented as fundamental public works throughout the country - from north to south, from suburbs to mountainous areas and in every rural village.

As explained above, social capital, which is accumulated simultaneously with the implementation of public works projects, has the potential to generate substantial public benefits, depending on how projects are implemented. Therefore, it can be concluded that there is a certain significance and necessity in the government's support in facilitating the formation and accumulation of social capital through public policies as a key source of public goods for sustainable rural development.

3. Case study of technical cooperation for water management capacity development in Cambodia

The following is an introduction of a technical cooperation project in Cambodia implemented in 2006-2009, which was set up as a Japanese ODA project in reference to the Land Improvement Act systems

3.1 Circumstances and objectives of the project

Agriculture in Cambodia accounting for 35% of GDP and 75% of national labor force in 2004 is a primal industry and has been placed as a key issue in national development policy. Cambodia is blessed with vast lands and ample water resources. However, agricultural productivity has stagnated due to the deterioration of agricultural infrastructure which has not yet been rebuilt with adequate technical support since it was completely demolished during the long civil war. Therefore, the Ministry of Water Resources and Meteorology (MOWRAM), Cambodia, in supervising irrigation agriculture, has placed the repair, proper maintenance and management of small and middle-scale irrigation facilities devastated during the civil war as the keystone of its rehabilitation strategy.

In particular, these are the problems in the areas of irrigation;

a) Shortage of irrigation engineers and training systems for them
b) Conventional plot-to-plot irrigation practices due to shortage of terminal canals which distribute water to the paddy plots although main canals exist
c) Difficulties in farmers' own initiated maintenance and water management at the terminal canal level

The government of Japan implemented a technical cooperation project in Cambodia from 2006 to 2009, as countermeasures to the background abovementioned issues, aiming to achieve the following;

a) Farmers' voluntary activities of water management in terminal canals
b) Technical upgrading for MOWRAM and its local offices (PDWRAM)

3.2 Contents of activities in the project

The project, designating a Technical Support Center (TSC) affiliated to MOWRAM as a counterpart organization, through technical instruction, grant of machinery and materials and training provided by Japanese experts, implemented the following activities;

a) Conducted technical instruction training on irrigation technology, developing training systems and technical manuals and systematizing technical information in TSC
b) Conducted training on irrigation techniques for government personnel and farmers in pilot project sites

Construction of a canal through the collaboration between municipalities and water users' association

Construction of a quaternary canal by a local farmers' group

3.3 Effects of the project

a) Continuous capacity development for engineers

As the training systems in TSC and technical manuals and information have been developed by the project, it is strongly expected that engineers in MOWRAM and PDWRAM will continuously receive the capacity development through the sustainable implementation of training by the government of Cambodia in the future.

b) Spread of double cropping

Development of irrigation facilities including terminal canals in the model site allowed widespread double cropping during the rainy season due to the introduction of advanced variety of rice. According to a questionnaire survey by interview, though the rate of double cropping practices in 2002 before the construction of canals was about 10%, it increased to 60% in 2008 after the construction. In particular in *Barku* area including the model site showed much higher rate of practices of double cropping than other neighbor areas.

c) Increase in yield

According to a questionnaire survey by interviewing farmers, the yield per unit area also increased from 2 MT/ha to 4 MT/ha on average as shown below, in which the effect of constructing terminal irrigation facilities was validated. Furthermore it was reported by the farmers that traffic access to fields and transportation of materials for production and harvested crops were improved in case of areas where farm roads for maintaining canals were equipped.

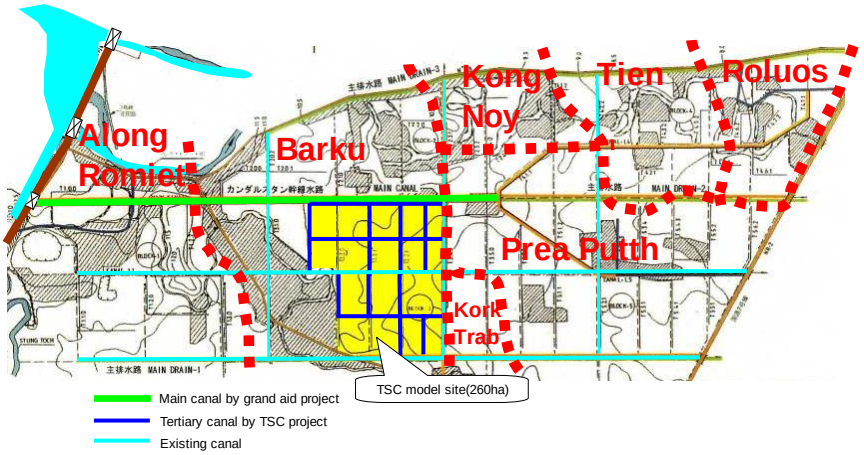


Fig.7 Ground-plan of the Kandal Stung Irrigation Project area

Table 3 Double cropping area by communes in *Kandal Stung* irrigation project area

Commune name	Double rice cropping area
Barku	210 ha
Along Romiet	0 ha
Prea Putth	50 ha
Kong Noy	14 ha
Kork Trab	2.5 ha
Tien	15 ha
Roluos	15 ha
Total	306.5 ha

Table 4 Yield per unit area by farmers in *Kandal Stung* irrigation project area

	Non-irrigated field	Irrigated field
Farmer A	3.0	4.0
Farmer B	-	4.5
Farmer C	2.0	3.5
Farmer D	-	5.0
Farmer E	1.5	3.0
Average	2.16	4.0

4. Conclusions – Policy recommendations for the Government of Indonesia

Agriculture in Indonesia is one of its primary industries and rice culture in particular has great importance from the viewpoint of national food security policy. It is necessary for the state not only to increase the production of rice, being a staple food to attain stable national food self-sufficiency, but also to establish a system for the production of quality rice based on the change in the nature of the present and future demand for better quality of rice because of the improved economic status of the consumers. For this purpose, it is necessary not only to invest in infrastructures, but also to improve the precision of water management for existing irrigation facilities to increase overall irrigation efficiency. In particular, improvement in the farmers' participatory irrigation management in terminal facilities such as tertiary canals and after them enables a boost in irrigation efficiency.

In Indonesia, the system of charging water fees from farmers, which is the financial base of water users' association has already been introduced since the 1980's and the policy of farmers' participatory irrigation management was provided clearly in the Water Resources Law amended in 2002.

Farmers' participatory irrigation management is widespread; however, irrigation efficiency in terminal facilities such as tertiary canals and after them is still low because the member farmers' motivation for a water management system was undermined due to various reasons preventing them from equally benefitting from a fair water distribution in many irrigation systems. It has built a vicious spiral of advancing functional deterioration in irrigation systems and water users associations' suspending proper operation and maintenance for irrigation facilities.

If one wants to stop such a vicious spiral and to maintain the better functioning of irrigation systems for improved irrigation efficiency, one has to implement, first of all, a fair water distribution from the main to the end terminals of the irrigation systems before one can launch a water policy reform for agriculture, which includes the introduction of a volumetric charging system or application of the full cost recovery principle to the irrigation fee collected from member farmers.

To put it concretely, recommendations to the Ministry of Agriculture (MOA) of Indonesia, as the administrative authority supervising terminal irrigation systems such as tertiary canals and after them, while receiving technical cooperation funds from donor countries like Japan, is to establish model project areas nationwide in which they can systematically build irrigation facilities as well as operation and maintenance systems to demonstrate the success story of fair water distribution from the main to the end terminal facilities of the irrigation systems. The MOA can promote advanced water users' associations in these model areas and show the sustainable synergy in the terminal irrigation communities. It can be disseminated to

other water users associations nationwide through their field visit and on-site trainings.

Moreover, it is recommended that the state examines the introduction of a project systems checking mechanisms, whether or not the beneficiary farmers have capacities for spontaneously initiating the project, i.e. the empowerment, and building governance with governments (central and local), i.e. the cooperative management of public space, while making reference to the systems of Japan's Land Improvement Act which successfully implemented irrigation and drainage projects introduced more than 60 years ago. It is expected that the project systems will enable the raising of the level of accumulated social capital nationwide in Indonesia and contributes to promoting further implementation of various public policies smoothly and effectively. Consequently, it is expected that the effectiveness of public policies to be applied in Indonesia in the future will be further strengthened, allowing the nation's financial burden to be reduced and promote social stability.