Kingdom of Cambodia

FY2017 Ex-Post Evaluation of Technical Cooperation Project

"Technical Service Center for Irrigation System Project -Phase 2

/The Improvement of Agricultural River Basin Management and Development Project (TSC3)"

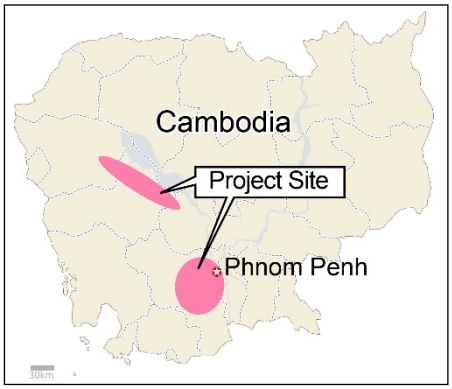
External Evaluator: Nobuyuki Kobayashi, OPMAC Corporation

0. Summary

This project aimed at promoting water management and securing agricultural productivity in and around the project sites in 6 provinces through capacity building of the implementing agency and irrigation associations. In Cambodia where the rice crop occupies 80% to 90% of the land area under cultivation, the purpose of this project was consistent with the country's policy and developmental needs which prioritized the development, maintenance and improvement of irrigation systems as well as the improvement of agricultural productivity. The project purpose was also consistent with Japan's aid policy, and therefore the relevance of this project is high. Before completion of the project, the implementing agency staff improved their capacity for irrigation system development and management as well as for extended irrigation management. Beneficiary farmers were organized, and their capacity for water management was reinforced. After project completion, Technical Service Center for irrigation System (TSC) has continued to promote capacity building of implementing agency staff through training. Provincial Department of Water Resources and Meteorology (PDWRAM), on the other hand, is maximizing its knowledge of the planning and designing of irrigation systems in order to apply for Japan's Grant Assistance for Grassroots Human Security Projects. At the time of the ex-post evaluation, the unit yield of rice among the beneficiary farmers at project sites was well maintained. The increase in agricultural income is contributing to improvements in farmers' livelihoods in general. As the realization of project effects can be confirmed, it is concluded that the effectiveness and impact of this project are high. The actual project period was in accordance with the original plan. The project cost, however, exceeded the original plan, mainly due to the increase in the dispatch of experts. Efficiency, therefore, is fair. There was no indication of significant problems that would affect the sustainability in terms of policies and techniques. From the organizational and financial aspects, the activities of Farmer Water Users Community (FWUC) were not always successful and some FWUC faced difficulties in the collection of irrigation service fees. For these reasons, the sustainability of the project effects is concluded to be fair.

In light of the above, this project is evaluated to be satisfactory.

1. Project Description



Project Locations

The canal rehabilitated by this Project

1.1 Background

As Cambodia developed in the early 2000s, agriculture was the country's prime industry, with rice as its most important agricultural product forming the backbone of the entire agricultural production. A deficient irrigation infrastructure in the country, however, was a factor that hampered the improvement of rice productivity. The civil war that had continued over two decades had destroyed much of the irrigation infrastructure, while that which existed faced problems of design and construction. Furthermore, it was difficult for the staff of the Ministry of Water Resources and Meteorology (referred to as "MOWRAM" hereafter) to acquire practical irrigation techniques as a result of the inadequate training systems designed for irrigation engineers and technicians.

Considering this situation, the Japan International Cooperation Agency (JICA) supported the improvement of agricultural productivity in Cambodia on the request of the Royal Government of Cambodia (RGC). A previous technical cooperation project, "The Technical Service Center for Irrigation Systems Project (2001-2006)" created the foundation for the spread of irrigation techniques through TSC (a training unit of MOWRAM). The current project consists of 2 independent projects: The Project for the Technical Service Center for Irrigation Systems Project Phase 2 (referred to as "TSC2" hereafter) and the Project for the Improvement of Agricultural River Basin Management and Development Projects (referred to as "TSC3" hereafter), both of which were conceived as follow-up to the afore mentioned "The Technical Service Center for Irrigation Systems Project." This project aimed at expanding the coverage of irrigation technology through TSC and the advancement of these techniques. While TSC2 carried out capacity building in the irrigation sector targeting PDWRAM staff (local branches of MOWRAM) and farmers in and around 3 areas in 3 provinces, TSC3 expanded this further to 11 areas in 6 provinces. It also aimed at capacity development in basin management and a shift from individual irrigation system management, to enable more efficient water resource management.

Table 1: Project Sites of the Current Project

	TSC2	TSC3
Target Provinces	Pursat Province, Kandal Province, and Takéo Province	Battanbang Province, Pursat Province, Kampong Chhnang Province, Kampong Speu Province, Kandal Province and Takéo Province
Project Sites	Thlear Maom, Kandal Stung, Thomney	Por Canal, Ream Korn, Wat Chre, Wat Loung, Thlear Maom, Damnak Ampil, Lum Hach, Roleang Chrey, Kandal Stung, Upper Slakou, Thomney

1.2 Project Outline

		TSC2	TSC3
Overall Goal		Livelihood of the farmer's households is improved by stabilizing their agricultural productivity through efficient water resource management in the irrigation areas conducted by the trained engineers and technicians in MOWRAM and PDWRAM.	Agricultural productivity in the target area is stabilized through efficient water resources management realized by improved technical capacity of MOWRAM and PDWRAM in agricultural river basin management and development.[1]
Project Purpose		1. The technical capacity of MOWRAM and PDWRAM is improved. 2. The farmers who have participated in the Project activities at the Pilot Sites[2] are able to practice water management in terminal canals.	Irrigation projects are properly planned, implemented, and operated in the target area of the Project.
Outputs	Output 1	The following outputs are expected to be achieved at TSC. 1-1 Establish the training system 1-2 Set up the technical manuals 1-3 Manage the technical information	TSC obtain capacities to implement training and provide technical support for MOWRAM and PDWRAM related to the agricultural river basin management and development.
	Output 2	The technical capacity of the engineers and technicians in MOWRAM and PDWRAM is well trained through the trainings at TSC and on-the-job trainings (OJT) at Model Sites and Pilot Sites.	The engineers and technicians in MOWRAM and PDWRAM obtain knowledge on concepts and technologies related to the agricultural river basin management and development through training.
	Output 3	With the technical assistance of TSC, the following outputs are expected to be achieved at Pilot Sites. 3-1 The trained engineers and technicians in PDWRAM construct the terminal canals, which make it possible for farmers to easily access irrigation water. 3-2 Farmers start to conduct water management activities at the terminal canals in cooperation with PDWRAM.	The capacities of the engineers and technicians of MOWRAM and PDWRAM on planning, survey, design, construction management, operation and maintenance (O&M) of facilities and structures in an irrigation system as a whole are improved through training.
	Output 4		The technical support system of TSC is established to promote implementation of irrigation projects nationwide by PDWRAM.
Total Cost (Japanese Side)		JPY 351 million	JPY 822 million
Period of Cooperation		January 2006 – July 2009	September 2009 – August 2014

[1] In the terminal evaluation report, the summary of the overall goal have minor differences between Japanese and English. However, it is confirmed that the description on the impact of the project were the same in two versions. For this reason, the above table is based on the descriptions in the terminal evaluation report.

[2] In TSC2, the model sites were for the purpose of OJT training for engineers and technicians while the pilot sites were locations where engineers and technicians had experience from actual practice.

	TSC2	TSC3
Implementing Agency	Ministry of Water Resources and Meteorology (MOWRAM)	
Other Relevant Agencies / Organizations	None	
Supporting Agency / Organization in Japan	The Ministry of Agriculture, Forestry and Fisheries	
Related Projects	[Technical Cooperation] • "The Technical Service Center for Irrigation System Project" (2001- 2006) • "Agricultural Productivity Promotion Project in West Tonle Sap" (2010-2015) • "Project for River Basin Water Resources Utilization in the Kingdom of Cambodia" (2014-2019) [ODA Loans] • "West Tonle Sap Irrigation Rehabilitation Project" (2011) [Grant Aid] • "The Project for the Rehabilitation of the Kandal Stung Irrigation System" (2005)	

1.3 Outline of the Terminal Evaluation

1.3.1 Achievement Status of Project Purpose at the Terminal Evaluation

The estimated achievement of the project purposes of the evaluated projects as of the terminal evaluation is described in the table below.

Table 2: Achievement status of Project Purposes (as of the Terminal Evaluation)

TSC2	As the majority of indicators set forth for training and terminal canal management had been attained, it was concluded that the project purpose was highly likely to be achieved
TSC3	Based on the lengths of the irrigation canals, the number of trainees, the activity level of FWUC as well as the utilization level of knowledge acquired by the PDWRAM engineers and technicians, it was concluded that the project purpose was likely to be achieved.

1.3.2 Achievement Status of Overall Goal at the Terminal Evaluation (Including other impacts)

The estimated achievement of the overall goals of the evaluated projects as of the terminal evaluation is described in the table below.

Table 3: Estimated Achievement of Overall Goals (as of the Terminal Evaluation)

TSC2	The area of irrigated fields at the national level (2007) was approaching the target, and that the unit yield of rice (2007/08) had already reached the target, it was concluded that the overall project goal was highly likely to be achieved.
TSC3	There was no explicit mention of the estimated achievement of the overall project goal.

1.3.3 Recommendations from the Terminal Evaluation

The recommendations made as of the terminal evaluation of the evaluated projects are detailed in the table below.

Table 4: Recommendations (as of the Terminal Evaluation)

TSC2	(1) Rapid disbursement of the Cambodian official budget, (2) Follow-up on the PDWRAM trainees outside the pilot provinces, (3) Organization of wrap-up workshops to further disseminate the project achievements, (4) Efforts to realize the Road Map for TSC institutionalization, (5) Human Resource Development for TSC personnel, (6) Utilization of project experience and outputs by MOWRAM.
TSC3	(1)Revision of the 2014 TSC plan, (2) Assignment of TSC staff in preparation for the beginning of the new technical cooperation project, (3) Minimization of construction activities in the model sites, (4) Provision of training to newly recruited MOWRAM staff, (5) Transfer to "FWUC for promoting O&M works" in the model sites, (6) Application of the project outputs to similar projects, (7) Improvement of the workforce age structure at MOWRAM, (8) Transformation of TSC as a higher education and research institute.

2. Outline of the Evaluation Study

2.1 External Evaluator

Nobuyuki Kobayashi, OPMAC Corporation

2.2 Duration of Evaluation Study

The ex-post evaluation study was conducted with the following schedule.

Duration of the Study: August 2017–August 2018

Duration of the Field Study: Nov. 12, 2017–Dec. 8, 2017, Mar. 20, 2018–Mar. 29, 2018

2.3 Constraints during the Evaluation Study

The project sites of this project were dispersed across 11 locations in 6 provinces. Due to time constraints on the field study, the external evaluator could only visit 4 sites (Thlear Maom, Damnak Ampil, Rloeang Cherey, Kandal Stung). As the project sites were concentrated in the north-west and the south of Cambodia, 2 sites were selected from each geographical area. The status of the other 7 sites as reported in this document is based on secondary information obtained from field survey assistants or the implementing agency. It should be also mentioned that physical inspection of the construction machinery, part of the high-value machinery supplied by this project, was not conducted as the said machinery was being used in the area inaccessible from the sites of this project for the implementation of other projects.

3. Results of the Evaluation (Overall Rating: B[3])

3.1 Relevance (Rating: ③[4])

There was a continuity between TSC2 and TSC3 in terms of project purpose and activities. The items analyzed for relevance, therefore, were mostly common to the two phases. Analysis and assessment were conducted for the combined results of both phases, at 3 points in time: at the time of planning of TSC2, at the completion of TSC2 and at the time of planning of TSC3, and at the completion of TSC3.

[3] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

[4] ③: High, ②: Fair, ①: Low

3.1.1 Consistency with the Development Plan of Cambodia

"*The Second Socio-Economic Development Plan 2001-2005*," the national development plan at the time of project planning for TSC2, drew attention to the low productivity of the agriculture sector, and concluded that an unstable water supply was making agriculture a high-risk activity. Among the 4 basic strategies of the "*Rectangular Strategy*" (formulated in 2004), strategy 1, "enhancement of the agricultural sector," aimed at the improvement of agricultural productivity, while strategy 2, "continued rehabilitation and construction of physical infrastructure," aimed at the expansion of irrigated field area and the efficient use of existing irrigation systems.

At the project completion of TSC2 and the project planning stage of TSC3, based on the above mentioned "*Rectangular Strategy*," the "*National Strategic Development Plan 2006 -2010*" set out objectives to increase the irrigated field area and the unit yield of rice. The sectoral plan, "*Strategy for Agriculture and Water 2006-2010*," on the other hand, set the tone for a shift in the unit of water resource management from an administrative unit base to a river basin unit base, eventually formulating an integrated land and water management plan per river basin.

At the project completion of TSC3, "*The Third Rectangular Strategy*" (formulated in 2013) was in place. In this, strategy 1, "Promotion of the Agricultural Sector" aimed at the improvement of agricultural productivity, including rice cultivation, while strategy 2, "Infrastructure Development" aimed at more effective management and operation of irrigation systems (continuous reinforcement of O&M systems). Meanwhile, "*The National Strategic Development Plan 2014-2018*" targeted an increase in rice cultivation area, production quantity and unit yield. It also drew attention to issues facing the irrigation sector including the low participation rate in FWUC and Farmer Water User Groups (FWUG[5]), and the need for the reinforcement of irrigation infrastructure management. Under "*Strategy for Agriculture and Water 2010-2013*" (formulated in 2010), the policy was to introduce a concrete basin-based management structure for integral water resource management.

From the planning phase of TSC2 to the project completion of TSC2 and the planning phase of TSC3 (2009), a development policy was put in place to improve agricultural productivity by realizing a stable water supply from irrigation. At the project completion of TSC3, the development of irrigation infrastructure and the strengthening of irrigation infrastructure management were still recognized as challenges for improvement of agriculture productivity. As both TSC2 and TSC3 aimed at the capacity building of MOWRAM and PDWRAM in the irrigation sector as well as the improvement of agricultural productivity in the project target areas, it can be said that the project purpose was consistent with development policy. Furthermore, TSC3 added basin irrigation management to the TSC training component, which

[5] FWUC consist, in general, of 3 to 9 FWUG, while each FWUG brings together from dozens up to 1,000 farmers. FWUC make decisions on matters that affect the entire FWUC such as the distribution of water and the collection of irrigation service fees. FWUG, on the other hand, are in charge of practical actions for the management and O&M of terminal canals.

aimed at capacity building for MOWRAM and PDWRAM in this area. This expansion of the training component was in accordance with the policy of the "*Agriculture and Water Strategy.*"

3.1.2 Consistency with the Development Needs of Cambodia

At the planning phase of TSC2, agriculture made up 34% of Cambodia's GDP (World Bank Data, 2003) and rice was the prime product, occupying 95% of land cultivated for food crops (as of 2005).[6] Low productivity of rice farming, on the other hand, was a factor that impeded increase in farmers' revenue, which in turn was one of the causes of urban-rural economic disparity in the country. The existing irrigation infrastructure was not adequately functioning. Reasons for inadequate functioning of irrigation infrastructure were said to be the civil war, that had lasted over a long period of time, and inappropriate infrastructure development. Demand for rehabilitation of the irrigation system was high, yet due to the civil war, there was a shortage in the number of irrigation engineers and technicians with practical experience. In addition, only a few staff at the implementing agency had an academic background in the irrigation sector. It was, therefore, necessary to supplement actual knowledge of irrigation work after recruitment.

At the project completion of TSC2 and at the planning phase of TSC3, agriculture continued to make up 36% of the country's GDP (World Bank Data, 2009), with rice occupying 87% of the land cultivated for food crops (as of 2009).[7] Of the irrigation systems (472,000ha in total) known to the Mekong Committee, no more than 256,000 ha (54% of the total irrigated area) was functioning. There were no programs at higher education institutions that taught irrigation techniques comprehensively and practically. The need at the implementing agency for post-recruitment training was therefore high.

As of the completion of TSC3, agriculture still accounted for 31% of Cambodia's GDP (World Bank Data, 2014), and paddy fields made up 81% of the land cultivated for food crops (2014).[8] Approximately 80% of the irrigation infrastructure constructed after 1978 was built under the Pol Pot regime, and much of this was known to have had problems in design and construction.[9] With regard to urban-rural economic disparity, per capita disposal income in rural areas was a third of that in Phnom Penh in 2014.[10] The training of irrigation engineers and technicians by higher education institutions continued to be limited. In particular, the university curriculum was not appropriate, expecting implementing agency staff to acquire practical knowledge in as short a period as one week.

Throughout the project implementation period, the agricultural sector continued to make up more than 30% of the country's GDP with rice being the principal crop. The irrigation

[6] National Institute of Statistics (2013), "Statistical Year Book 2013." The definition of food crop in this statistics data include rice, maize, cassava, sweet potato, vegetable and mung bean.
[7] National Institute of Statistics (2013) "Statistical Year Book 2013"
[8] National Institute of Statistics (2013) "Statistical Year Book 2013"
[9] International Water Management Institute (2013) "Agriculture Water Management Planning in Cambodia"
[10] National Institute of Statistics (2016) "Cambodia Socio-Economic Survey 2015"

infrastructure that is pivotal to rice production, however, was still inadequate at project completion and this was considered as a factor that hampered the improvement of rice productivity. There was no change in the situation before and after the project where TSC was put in charge of practical educational programs for the human resource development of irrigation engineers and technicians. Both TSC2 and TSC3 promoted capacity building in the areas of planning, design, construction and O&M of irrigation infrastructure through TSC in order to improve rice productivity in the project target areas. The project purpose was, therefore, consistent with above mentioned development needs.

3.1.3 Consistency with Japan's ODA Policy

At the planning phase of TSC2, Japan's Country Assistance Program for Cambodia (formulated in 2002) placed importance on balanced development between urban and rural areas. The priority area of the policy included the "realization of sustainable economic development and a stable society," envisaging work on "agriculture and rural development, and agriculture productivity improvement."[11] The backdrop to this aid policy was the economic disparity between the capital city and the provinces. Rural development was given priority, as a result, to achieve balanced development. The improvement of agricultural productivity was indispensable for poverty alleviation in rural areas. Improvement of water management systems as well as the development of FWUC/FWUG were proposed as concrete measures. At the planning phase of TSC3, aid to the country was still based on the above-mentioned country assistance program.

The overall goals of TSC2 were the stabilization of agricultural production and the improvement of farmers' livelihoods, while that of TSC3 was the stabilization of agricultural productivity in the target areas. The achievement of these overall goals of TSC2 and TSC3 would contribute to the priority area of the Country Assistance Policy, "agricultural and rural development, and agriculture productivity improvement." It is concluded, therefore, that there was a consistency between the evaluated project and Japan's aid policy.

This project was highly relevant to the country's development plan and development needs, as well as Japan's ODA policy. Therefore, its relevance is high.

3.2 Effectiveness and Impact[12] (Rating: ③)

3.2.1 Effectiveness

The project purpose of TSC2 was to build up the capacity of MOWRAM and PDWRAM staff as well as that of beneficiary farmers for knowledge and skills related to the respective irrigation systems in 3 provinces. TSC3, on the other hand, expanded the project target area, and in its

[11] Ministry of Foreign Affairs (2002). "Country Assistance Program for Cambodia"
[12] Sub-rating for Effectiveness is to be put with consideration of Impact.

project purpose aimed at building the capacity for basin irrigation management. The project purpose of TSC2 was an important goal as foundation for the implementation of TSC3. For this reason, after the purposes of TSC2 and TSC3 were assessed individually, the level of overall achievement was evaluated giving them equal weightage.

3.2.1.1 Project Output

(1) TSC2

As indicated in the following table, it is concluded that the 3 sets of outputs set were achieved.

Table 5: Achievement of Outputs (TSC2)

Outputs	Actual
The following outputs are expected to be achieved at TSC. 1-1 Establish the training system 1-2 Set up the technical manuals 1-3 Manage the technical information	Achieved. The following items were completed before the end of TSC2: (a) Curricula for 38 courses. (target:33 courses), (b) 14 types of training materials (target: 14 types), (c) List of technical manuals and book collection (target: creation of a list of technical manuals and book collection), (d) 9 types of technical manuals (target: 8 types), (e) technical information library (target: completion of technical information library).
The technical capacity of the engineers and technicians in MOWRAM and PDWRAM is well trained through the trainings at TSC and on-the-job trainings (OJT) at Model Sites and Pilot Sites.	Achieved. Before the completion of TSC2, the length of terminal canal which the implementing agency planned and rehabilitated reached 8,200 m (target: 4,490m). 604 engineers and technicians of MOWRAM and PDWRAM attended 38 training courses (target: 520 technicians), 465 engineers and technicians of MOWRAM and PDRAM as well as 194 representatives of farmers attended the OJT at the model sites/ pilot sites (target 510 participants among engineers, technicians and farmers). 30 counterparts of PDWRAM in 3 provinces participated in the OJT along with canal rehabilitation (target: 21 counterparts).
With the technical assistance of TSC, the following outputs are expected to be achieved at Pilot Sites. 3-1 The trained engineers and technicians in PDWRAM construct the terminal canals, which make it possible for farmers to easily access irrigation water. 3-2 Farmers start to conduct water management activities at the terminal canals in cooperation with PDWRAM.	Achieved. Before the completion of TSC2, 18.3 km of terminal canals (the tertiary and distribution canals) was developed (target: 5km or longer). PDWRAM finalized the basic design of 3 pilot sites (target: 3 pilot sites). As a result of 65 workshops and FWUC/FWUG meetings at the model sites and respective pilot sites, O&M activities for the irrigation canals (weeding, mud removal, repair of earth canals, slope protection, etc.) were conducted in 3 pilot sites (target: onset of operation and maintenance activities in 3 pilot sites.)

Source: Project completion report of TSC2, and the terminal evaluation report for TSC2

(2) TSC3

As indicated in the following table, it is concluded that the 4 sets of outputs were either achieved or mostly achieved.

Table 6: Achievement of Outputs (TSC3)

Outputs	Actual
TSC obtain capacities to implement training and provide technical support for MOWRAM and PDWRAM related to the agricultural river basin management and development.	Mostly achieved. According to interviews conducted with the implementing agency, as of the completion of TSC3, 70% of staff members assigned to TSC were involved in trainings, although this was somewhat below the target (90%). The majority of PDWRAM staff (96%) who received training at TSC reported that they were satisfied with the contents of the training (target: satisfaction rate 80%).
The engineers and technicians in MOWRAM and PDWRAM obtain knowledge on concepts and technologies related to the agricultural river basin management and development through training.	Achieved. As of the completion of TSC3, 20 training courses on the above-mentioned area were conducted for MOWRAM and PDWRAM engineers and technicians (target: 15 courses). On average, 88.7% of participants in these 20 courses attained the objectives of the training courses, which exceeded the target success rate (60%).
The capacities of the engineers and technicians of MOWRAM and PDWRAM on planning, survey, design, construction management, operation and maintenance (O&M) of facilities and structures in an irrigation system as a whole are improved through training.	Achieved. Before the completion of TSC3, 32 training courses were conducted (target: 12 courses). Training covered the life cycle of irrigation systems (from planning to O&M). Advanced courses were also provided. On average 91.4% of participants in these 32 courses attained the objectives of the training courses, which exceeded the target success rate (60%).
The technical support system of TSC is established to promote implementation of irrigation projects nationwide by PDWRAM.	Achieved. During the project period, PDWRAM engineers and technicians formulated 31 irrigation project plans with the help of TSC (Target: 30 projects).

Source: Project completion report of TSC3, the terminal evaluation report for TSC3, interviews with staff of the implementing agency.

3.2.1.2 Achievement of Project Purpose

(1) Achievement of Project Purpose (TSC2)

TSC2 had 2 project purposes: firstly, to build the capacity of implementing agency staff in technical areas, and secondly to build the capacity of farmers in the area of the O&M of irrigation canals. Implementing agency staff who participated in the training had their level of technical skill raised and were satisfied with content of the training. It is therefore concluded that the project purpose 1 was achieved. Furthermore, FWUG and beneficiary farmers who have O&M activities for canals have exceeded the target numbers. It is therefore concluded that the project purpose 2 also was achieved. Thus, TSC2 achieved its project purposes.

Table 7: Achievement of Project Purpose (TSC2)

Project Purpose	Indicator	Actual
Project Purpose 1 The technical capacity of MOWRAM and PDWRAM is improved.	1-1: More than 60% of engineers and technicians who participated in the training and OJT achieve the assigned target in the curricula.	Achieved. During the mid-term evaluation of TSC2, the detailed indicators and targets were set with the criteria: (a) Participants will self-evaluate their levels of technical skills and report improvements of at least 1 grade in the five-grade scale. (b) Examination scores will be 60 points, and (c) There will be the intention to use the acquired skills. According to the post-training questionnaire for 38 training courses (number of valid responses 582), 72% of participants reached the target.
	1-2: More than 80% of trainee is satisfied with the training courses and management system.	Achieved. According to the post-training questionnaire with 38 training courses (number of valid responses 589), 93% of participants were satisfied with the training.
Project Purpose 2 The farmers who have participated in the Project activities at the Pilot Sites are able to practice water management in terminal canals.	2-1: No less than 9 water user groups are active in water management.	Achieved. Before completion, 10 FWUG in total in each pilot site had started water management. FWUG play a role in the actual O&M of irrigation systems. Activities such as the formulation of canal O&M plans, and channel excavation were initiated by group leaders and local authorities.
	2-2: No less than 360 farmers start the water management works learned at the Project.	Achieved. At completion, 461 farmers were participating in water management work at the pilot sites. At the pilot sites, canal cleanup activities and repair work (weeding of tertiary and distribution canals, mud removal and watercourse repair) were conducted. In Kandal Stung, water distribution rules were agreed with the participation of farmers. In Pursat, farmers drew a water resource map[13]

(2) Achievement of Project Purpose (TSC3)

During the implementation of the project, targets were not set for the TSC3 project purpose indicators. For the purpose of the ex-post evaluation, the targets were retroactively set, based on the similar indicators of TSC2 and the amount of cooperation, and the assessment was carried out working against those.[14] As described in the following table, the design and implementation of the irrigation projects at model sites, the length of the extension of terminal canals and the number of engineers and technicians who received training at TSC all reached their targets. Effects were also observed to a certain extent in terms of the number of FWUG created and the number of their activities. Thus, TSC3 largely achieved its project purpose.

Workshop
(provided by the implementing agency)

[13] A map that identifies water flow, risk points for flood and drought, and points with noticeable soil erosion.
[14] In concrete terms, the targets of similar indicators set for TSC2 were multiplied by the increase rate of the amount of cooperation (2.34 times, TSC2: JPY 351 million, TSC3: JPY 822 million)

Table 8: Achievement of Project Purpose (TSC3)

Project Purpose	Indicator	Actual
Project Purpose Irrigation projects are properly planned, implemented, and operated in the target area of the Project.	1-1: Number of the newly formulated irrigation projects in the target area, which are planned and designed based on the water supply circulation.	Achieved. Before the end of the project, irrigation projects were designed and implemented at model sites in 8 areas. Based on the target set for TSC2 (basic design formulated at 3 sites), the target for TSC3 would have been 7.
	1-2: Total length of rehabilitated irrigation canal of the project	Achieved. Before the end of the project, a total canal of 144,535m (of which 11,137m was secondary canal and 133,398m was tertiary and distribution canals) had been developed. Based on the target set for TSC2 (5km of terminal canal developed), the target for TSC3 would have been 11.7km.
	2: Number of PDWRAM engineers and technicians who obtained appropriate operation skills through TSC training, and Number of PDWRAM engineers and technicians who conducted any activities in the target areas of the project after training.	Achieved. Before the end of the project, 1,305 engineers and technicians received training at TSC. Before the terminal evaluation, 39 PDWRAM engineers and technicians carried out activities related to this project (rehabilitation work, O&M workshops, etc.). Based on the target set for TSC2 (520 and technicians trained at TSC), the target for TSC3 would have been to train 1,217 engineers and technicians.
	3: Number of farmers group (water user committee and so on) for maintenance are newly established, and periodical O&M activities.	Partially achieved. Before the end of the project, 9 FWUG were set up at 3 model sites. O&M activities carried out by farmers' organizations before the end of the project totaled 17. As there was no similar indicator in TSC2, the achievement level was concluded to be fair.

3.2.2 Impact

The model project sites of TSC3 include model sites and pilot sites of TSC2. The indicators of the overall goals of TSC3 were set exclusively for the areas focused on by the project. It is considered that these indicators demonstrate the project effects more directly than those of TSC2 which targeted the whole of Cambodia. The overall goals of TSC2 and TSC3 were each assessed first, but, for the reasons given above, the achievement level of the overall goals of TSC3 was given more weight in the final evaluation conclusion.

3.2.2.1 Achievement of Overall Goal

(1) Achievement of Overall Goal (TSC2)

The irrigated field area and unit yield of rice in Cambodia as a whole were set as indicators of the overall goal of TSC2. As indicated in Tables 9 and 10 below, the target was met for the year after project completion. Irrigated areas continued to increase after project completion. The unit yield of rice is maintained above 3.0t/ha, which is above the target. Thus, TSC2 has achieved its overall goal. It is expected that the effects of the project will influence the whole country as the TSC training targeted PDWRAM staff in the country as a whole. It is assumed, however, that external factors influence the fluctuation of indicators as the project was conducted mainly in 3 provinces by utilizing model sites and pilot sites in. According to data

collected from the implementing agency, the unit yield in the project target provinces (average of Kandal, Takéo, and Pursat) improved from 2.96t/ha at the outset of the project (2005/2006) to 3.59t/ha (2015/2016) after project completion.

Table 9: Achievement of Overall Goal (TSC2)

Overall Goal	Indicator	Actual
Overall Goal Livelihood of the farmer's households is improved by stabilizing their agricultural productivity through efficient water resource management in the irrigation areas conducted by the trained engineers and technicians in MOWRAM and PDWRAM.	1: Irrigated area is increased to 810,300ha in 2010 as indicated as a target of the National Strategic Development Plan 2006-2010	Achieved. The area of irrigated fields at the national level in 2010 was 906,038ha, which reached the target. The irrigated field area has since continued to increase (see Table 10)
	2: Unit yield of rice is improved to 2.50t/ha in 2010 as indicated as a target of the National Strategic Development Plan 2006-2010.	Achieved. According to agricultural statistics, the unit yield of rice (national average) was 3.0t/ha in 2010, 3.2t/ha in 2011, 3.1t/ha 2012 and 3.2t/ha in 2013.[15] According to data collected from the implementing agency, national average for the 2015/2016 season also reached 3.1t/ha.

Table 10: Irrigated Area in Cambodia

Year	Irrigated Area (ha)	Year	Irrigated Area (ha)
1998	408,000	2008	815,855
1999	413,963	2009	838,338
2000	429,486	2010	906,038
2001	485,870	2011	944,834
2002	510,030	2012	1,014,590
2003	561,149	2013	1,077,416
2004	587,397	2014	1,148,893
2005	629,191	2015	1,230,348
2006	711,371	2016	1,285,561
2007	762,487	2017	1,320,409

Source: Answers for the questionnaire to the implementing agency

(2) Achievement of Overall Goal (TSC3)

The unit yield of rice at the model sites and the field areas where appropriate irrigation had been made possible were set as indicators for the overall goal of TSC3. The target for the unit yield of rice (3.0t/ha) set during the project period had been achieved by the end of the project. The results of the quantitative survey (a summary of which appears in "Column: Quantitative Survey" later in this report) demonstrated, as indicated in Table 12, that there had been no significant change in the unit yield at the time of the ex-post evaluation. The indicator still exceeds the above-mentioned target. The field area where appropriate irrigation had been made possible (cultivated area where rice is planted once or more per year) also increased as some model sites continued irrigation development after project completion (see the table below).

[15] National Institute of Statistics (2013) "Statistical Year Book 2013"

Interviews with farmers at the model sites[16] revealed that agriculture extension services from local offices of the Ministry of Agriculture, Forestry and Fisheries,[17] NGO, and the JICA technical cooperation project "Agricultural Productivity Promotion Project in West Tonle Sap" helped many farmers to introduce high yield varieties and double cropping. As for qualitative changes, it was found that the use of pumps decreased in general after project implementation, and, in turn, fuel costs also showed a declining trend. Before the project, farmers frequently used pumps to draw water from water sources such as ponds and wells. In areas with insufficient water outside the model sites, no change in this aspect has been observed and pumps continue to be in use. At the model sites, there is less need to draw water during water shortage seasons thanks to the irrigation system development. The cost of fuel for pump operation is decreasing accordingly. The unit yield of rice and the irrigated field area both suggest stability of agricultural productivity. Thus, TSC3 has achieved its overall goal.

Table 11: Achievement of Overall Goal (TSC3)

Overall Goal	Indicator	Actual
Overall Goal Agricultural productivity in the target area is stabilized through efficient water resources management realized by improved technical capacity of MOWRAM and PDWRAM in agricultural river basin management and development.	1: Unit yield of rice and other crops in the target area of the project is improved to reach the national target.	Achieved. The unit yield of rice at the outset of the project (2009) was 2.74t/ha (model site average) against the national-level target of3.0t/ha. The unit yield of rice at the end line survey[18] in 2012 at 11 model sites was 3.24t/ha (average among respondents). The quantitative survey of the ex-post evaluation in 2017 revealed the unit yield of rice as 3.11t/ha (average among respondents), which more or less maintains the 2012 level (see Table 12). In the quantitative survey, a slight decrease in the land area under cultivation can be accounted for by : (a) decrease in water quantity in Damnak Ampil and Lum Hach due to construction work on other projects,[19] (b) reporting of the situation in non-project land by some farmers in their responses to the end line survey, and (c) beneficiary farmers who passed down their land to their heirs as gifts while they are still alive due to old age, etc.
	2: Irrigated field area is increased due to the efficient water utilization and distribution in the target area of the project (including double cropping and triple cropping)	Achieved. At the completion of TSC3 (2014), the total field area with appropriate irrigation at 8 model sites where construction works were conducted was 3307ha (of which 349ha was good for double cropping, and 12ha good for triple cropping). According to data collected from the implementing agency, the total field area with appropriate irrigation at 8 model sites as of 2017 had increased to 3,958ha (of which 960ha was good for double cropping and 400ha good for triple cropping.) As Kandal Stung accounts for the majority of the increase in the irrigated fields, continuous irrigation development in the said site can be considered as the main reason for the increase in land area. Securing an adequate amount of water is an important factor in continuously improving the rice productivity. The expansion of the irrigated field area indicates that this requirement is being met at the model sites.

[16] A qualitative survey (13 beneficiary farmers, 6 beneficiary/non-beneficiary famers who have land under cultivation both in and out of the model sites, 8 non-beneficiary farmers. Of 27 interviewees, 19 were men and 8 were women) was conducted at the model sites of TSC3 (Kandal Stung, Thlear Maom, Damnak Ampil, and Roleang Chrey).
[17] MOWRAM is not in charge of agriculture extension services.
[18] Data collection for the end line survey was conducted in 11 model sites of TSC3 in late 2013. As a part of data collection, a questionnaire survey was carried out with PDWRAM, FWUC/FWUG, and beneficiary farmers.
[19] At the time of the ex-post evaluation, the implementing agency was planning remedial works at these two sites.

Table 12: Rice Production in the Model Sites (quantitative survey results)

	2012 Production (t)	2017 Production (t)	Difference (t)	2012 Cultivated area (ha)	2017 Cultivated area (ha)	Difference (ha)	2012 Unit yield (t/ha)	2017 Unit yield (t/ha)	Difference (t/ha)
Valid Response	124	110	-14	124	110	-14	124	110	-14
Average	7.60	6.88	-0.72	2.39	2.18	-0.21	3.24	3.11	-0.13
Standard deviation	9.44	11.81	2.37	2.47	3.51	1.04	1.23	1.13	-0.10
Median	4.27	3.65	-0.62	1.5	1.2	-0.30	3.43	3.14	-0.29

Source: The quantitative survey in this ex-post evaluation

[Column] Quantitative Survey

(1) Outline of survey

The ex-post evaluation conducted a follow-up study to the end-line survey as a quantitative survey. The survey aimed at assessment of the project effects after project completion. The outline of the survey is as follows:

Study population: beneficiary farmers in the model sites of TSC3 (11 locations in six provinces)

Target households: households in the end-line survey (130 households)

Data collection period: December 25, 2017 – January 9, 2018

Data collection method: Questionnaire survey (face-to-face questionnaire)

Dropout rate: 11.5% (15 dropout households÷130 households in the end-line survey)

Main questions: Questions related to cultivated area, production amount, household expenditure by item, changes in household incomes, etc.

(2) Analytical method and survey result

Statistical tests to compare two independent samples were conducted in order to assess differences between the end line survey and the quantitative survey of the ex-post evaluation. Type of statistical tests were selected in consideration of a) difficulties in precisely pairing samples in both surveys using respondents' names and b) the distribution of data to be tested. The tests show that there was no change in rice production but that there were some changes in household spending (see the table below). Given the results of descriptive statistics, it is suggested that household expenditure increased after project completion (see Table 15).

Data	Type of test	Significance level	Difference
Production amount of rice	Brunner-Munzel Test (two-tailed)	5%	No
Cultivated area of rice	Brunner-Munzel Test (two-tailed)	5%	No
Unit yield of rice	Welch's t-test for 2 independent samples (two-tailed)	5%	No
Household healthcare expenditure	Brunner-Munzel Test (two-tailed)	5%	Yes
Household educational expenditure	Brunner-Munzel Test (two-tailed)	5%	No
Total household expenditure	Brunner-Munzel Test (two-tailed)	5%	Yes

(3) Notes

- The cultivated areas in the end line survey contain not only the areas within the model sites in the quantitative survey but also the areas cultivated by beneficiary farmers outside the model sites. Therefore, the cultivated areas of rice in the end line survey tend to be larger than those in the current quantitative survey.
- The target households were selected in the baseline survey[20] and the sampling was conducted with consideration of bias regarding in the size of a farm. Nevertheless, it was

[20] The baseline survey collected data from beneficiary farmers at 11 model sites of TSC3 in 2010.

not confirmed that random sampling was carried out rigorously. Thus, over/underestimation of the differences between the two groups cannot be ruled out.
・ Due to the above limitations, the test results are considered to be merely one part of the evidence. The judgment made reflected other information such as descriptive statistics of this quantitative survey and the answers to the questionnaire of the implementing agency.

(3) Realization of Project Outputs and Project Purpose

● The current situation of the training conducted by TSC

TSC continued with training activities after the completion of TSC3. As shown in the following table, this training holistically covers the life cycle of irrigation systems (from planning to O&M). TSC training provides implementing agency staff with the opportunity to acquire practical knowledge in a short period of time. At the time of the ex-post evaluation, technical manuals made during the project were being utilized as training materials. The implementing agency also said that all training materials were available in Khmer except for the GIS related lectures where the translation of technical terms had proved difficult.

Table 13: The Situation of Training Given by TSC at the Time of Ex-post Evaluation

Training contents	**2015***	**2016***	**2017***
Crop water requirement	1		
Construction management and supervision	1		
Design and drawing for irrigation canals and canal structure	1		
O&M of irrigation facilities	1	1	
Basics of topographic and route surveys		1	
Participation of farmers in sustainable irrigation system management		1	1
Irrigation planning by GIS		1	
Basic administration of FWUC committees		1	1
Enhancement of agricultural extension services with rice cultivation technology			1
Data collection methodology for agricultural river basin management using remote sensing.			1
FWUC strengthening at model sites			8
Total	4	5	12

Source: MOWRAM
Note: *The data was collected between April and the following March.

PDWRAM staff trained by TSC are involved in the formulation of irrigation projects and continue to coach FWUC/FWUG (for O&M, group management and the collection of irrigation service fees) at the model sites in which TSC3 conducted rehabilitation works. Interviews with PDWRAM staff revealed that the surveying techniques and map drawing techniques were used for rehabilitation work and O&M planning. Knowledge about participatory irrigation management seemed to be used more frequently in assisting farmers.

- Project formulation for Grant Aid for Grassroots Human Security

Of 6 provinces supported by TSC3, the PDWRAM of 4 provinces are formulating project plans to apply for Grant Assistance for Grassroots Human Security Projects, which Ministry of Foreign Affairs of Japan supports. Plans formulated by PDWRAM will be reviewed by TSC. TSC also supports the revision of plans where necessary. Of all projects formulated by PDWRAM in the target provinces since 2015, 5 projects from 3 provinces were approved (see the following table). This proves that the implementing agency has acquired the ability to formulate irrigation project plans autonomously and with the appropriate quality. Sustainable improvement in agricultural productivity via the formulation of these irrigation projects can be expected. Interviews with PDWRAM staff revealed that capacities acquired during the project is being used in the formulation of the irrigation project plans. It was also reported that knowledge of GIS in particular was very effective.

Table 14: Approval of Grant Aid for Grassroots Human Security in the Target Provinces

Province	2015	2016	2017
Battangbang	1 project		
Pursat	1 project	1 project	1 project
Kampong Chhnang			1 project

Source: Answers for the questionnaire to the implementing agency

3.2.2.2 Other Positive and Negative Impacts

(1) Impact on natural environment

The project carried out infrastructure development for irrigation. The construction work involved mainly small-scale rehabilitation of existing infrastructure (irrigation canals, dam dykes). No negative impact on the natural environment was observed through the interviews with the implementing agency or during the site surveys at 4 model sites.[21]

Terminal canal rehabilitated by this Project

(2) Resettlement and Land Acquisition

According to the responses to the questionnaire filled out by the implementing agency, there was no resettlement of residents or land acquisition in this project. No complaint was reported regarding resettlement or land acquisition during the field surveys at the 4 model sites or in the

[21] In this ex-post evaluation, the irrigation facilities rehabilitated by this project were inspceted at four sites (Kandal Stung, Thlear Maom, Damnak Ampil, and Roleang Chrey).

interviews with residents. It is considered, therefore, that there was no negative impact deriving from relocation or land acquisition.

(3) Livelihood changes among beneficiary farmers

In the quantitative survey, data on household expenditure was collected in order to define the changes in farmers' livelihoods after project completion (see Table 15). Total household expenditure (Riel-base, adjusted for inflation) increased in both average and median terms between 2012 and 2017. The quantitative survey also collected opinions on changes in agricultural and non-agricultural income after project completion, and a majority reported an increase in both (see Table 16). According to beneficiary farmers of Roleang Chrey, their expenditures could have remained the same or increased very little if their agricultural incomes had not increased. Health-related expenditure saw a significant increase between 2012 and 2017, while education-related expenditure decreased somewhat in the same period. According to interviews with the beneficiary farmers, education-related expenditure tends to fluctuate according to the number and age of children. It is considered, in other words, that it is largely influenced by factors other than income.

Table 15: Household expenditure in the model sites (quantitative survey results)

	2012 Health expenditure (Riel)	2017 Health expenditure (Riel)	Difference	2012 Education expenditure (Riel)	2017 Education expenditure (Riel)	Difference	2012 Total expenditure (Riel)	2017 Total expenditure (Riel)	Difference
Valid Response	130	115	-15	130	115	-15	129	115	-14
Average	557,669	1,277,193	719,524	1,189,938	1,166,244	-23,694	12,345,033	15,795,793	3,450,760
Standard deviation	1,048,658	2,798,995	1,750,337	1,741,635	1,596,370	-145,264	7,995,961	9,246,845	1,250,885
Median	275,000	436,600	161,600	697,500	611,241	-86,259	9,966,000	13,401,788	3,435,788

Source: The quantitative survey in this ex-post evaluation

Table 16: Change in income after project completion (quantitative survey results)

Answer	Agricultural Income		Non-Agricultural Income	
	Responses	%	Responses	%
Increased	42	36.5%	21	18.6%
Moderately increased	51	44.3%	75	66.4%
Same	13	11.3%	14	12.4%
Moderately decreased	7	6.1%	3	2.7%
Decreased	2	1.7%	0	0.0%
Total	115	100.0%	113	100.0%

Source: The quantitative survey in this ex-post evaluation

This project has largely achieved the project purpose of improving the technical capacity of employees in the implementing agency and the capacity of farmers for the O&M of irrigation canals, and the overall goal in terms of improvement and stability in agricultural production at the model sites. Therefore, effectiveness and impact of the project are high.

3.3 Efficiency (Rating: ②)

Actual project expenditure differed greatly between TSC2 and TSC3. Both also faced different types of problems during their respective implementation. With this in mind, assessment was carried out for each phase, in order to present the efficiency of each project.

3.3.1 Inputs

Plan and actual inputs of the project are shown in the following table.

Table 17: Inputs of TSC2 (Plan and Actual)

Inputs	Plan	Actual (at the Project Completion)
(1) Experts	3 Long-term (No target indicated for M/M) Short-term as necessary in 6 areas (15 M/M per year)	4 Long-Term (111 M/M) 14 Short-Term (35 M/M)
(2) Trainees received	No target indicated for the number of trainees	12 persons
(3) Equipment	Survey equipment (total stations, reflectors, levels drawing tables), training equipment, etc.	Office equipment, vehicles, equipment for design, survey, monitoring of water gates, construction, etc.
(4) Third Country Training	No target indicated for the number of trainees	3 persons
(5) Local Costs	JPY 55 million	JPY 97 million
Japanese Side Total Project Cost	Total JPY 360 million	Total JPY 351 million
Cambodian Side Total Project Cost	No target indicated	Total JPY 24 million (Local cost charge)

Source: the ex-ante evaluation sheet of TSC2, preparatory study report of TSC2, and project completion report of TSC2

Table 18: Inputs of TSC3 (Plan and Actual)

Inputs	Plan	Actual (at the Project Completion)
(1) Experts	3 Long-term (No target indicated for M/M) Short-term as necessary in 7 areas (No target indicated for M/M)	6 Long-Term (181 M/M) 26 Short-Term (65 M/M)
(2) Trainees received	No target indicated for the number of trainees	33 persons
(3) Equipment	Vehicles, equipment for surveys and experiments, office and training equipment	Office equipment, vehicles, construction machinery (including heavy machinery), survey equipment
(4) Third Country Training	No target indicated for the number of trainees	7 persons
(5) Local Costs	JPY 70 million	JPY 265 million
Japanese Side Total Project Cost	Total JPY 370 million	Total JPY 822 million
Cambodian Side Total Project Cost	No target indicated	Total JPY 69 million (local cost charge)

Source: The ex-ante evaluation sheet of TSC3, preparatory study report of TSC3, and project completion report of TSC3

3.3.1.1 Elements of Inputs

(1) TSC2

Japanese side: A comparison of the planned and actual inputs demonstrated that the dispatch of short-term experts was shortened, while the local cost charge absorbed by Japan increased.

These differences resulted from the inclusion in the project scope of canal development in pilot sites. During implementation, the target of the OJT training by TSC2 was expanded from model sites to pilot sites. Based on this development, the decision was made to include the canal development of the pilot sites in the project scope as terminal canal development was deemed effective for OJT.

Cambodian side: Inputs were made by the implementing agency by way of the assignment of 50 counterparts in total, the provision of project office and related equipment, and the absorption of local costs (labor costs, office expenses, facility maintenance costs, etc.)

(2) TSC3

Japanese side: A comparison of the planned and actual inputs demonstrated that the local costs absorbed by the Japanese side increased as construction equipment, including heavy machines, was later added to the items for equipment provision. At the planning phase, the securement of funds by Cambodia for the irrigation project in the project target areas was placed as an external factor: It was assumed that canal development in the model sites would be covered by the ODA loan project, the "West Tonle Sap Irrigation Rehabilitation Project" (Loan agreement signed in 2011. Under implementation as of the ex-post evaluation). There was a delay, however, in the said ODA loan project, and this project was forced to add to its scope irrigation infrastructure development in 8 model sites that was not in the original plan. The training of PDWRAM and farmers was not sufficient in itself for the realization of the project effects that were assumed by the overall goal of the project (increase of unit yield of rice in model sites and an expansion in the area of irrigated fields). The development of irrigation infrastructure was necessary. Due to non-negligible constraints for project implementation (budget, project period, implementing agency staff), however, some rehabilitation work was foregone in provinces that had multiple model sites. In three such model sites where the repair work was not conducted under the project, irrigation infrastructure is still not fully developed. However, it is inferred that there would have been a higher chance of impediment in the realization of project effects if TSC3 had not expanded its project scope. The additional expenditure, therefore, is considered to have been appropriate.

Cambodian side: Inputs were made by the implementing agency in terms of the assignment of 16 counterparts in total, the provision of project office and related equipment, and the absorption of local costs (project activity costs).

3.3.1.2 Project Cost

(1) TSC2

The actual project cost on the Japan side (amount of cooperation) was JPY 351 million against a planned cost of JPY 360 million (98% of the plan). This was within the original plan. The reason why the actual total project cost was slightly below the planned cost is considered to have been because the increase in local costs absorbed by the Japan side was balanced out by the decrease in the dispatch period of short-term experts.

(2) TSC3

As mentioned before, irrigation infrastructure development components that were not in the original plan were later added to the project scope. Adding the direct costs of irrigation infrastructure development work (specifically, JPY 130 million for construction work at model sites and an increase of JYP 78 million for equipment provision) to the original planned amount (JPY 370 million), the planned project cost for the Japan side (amount of cooperation) totals JPY 578 million.

Compared with the planned amount after adjustment, the actual project cost was JPY 822 million (142% of the planned amount), which exceeded the plan. This increase in project cost that exceeded the plan was mainly due to the increase of short-term experts. The reasons for the latter are: (a) the project coverage of TSC3 encompassed diverse aspects from water source development to terminal cultivated land management, and (b) guidance was required for restoration work after the flood disaster of 2011.

3.3.1.3 Project Period

(1) TSC2

For TSC2, the actual and planned project periods were 3 years and 7 months[22] (100% of the planned period) as planned. The opinion of the implementing agency is that the timing of the dispatch of experts was mostly appropriate.

(2) TSC3

For TSC3, the actual and planned project periods were 5 years (100% of the planned period) as planned. The opinion of the implementing agency is that the timing of the dispatch of experts was mostly appropriate.

While the project period remained within the plan, the project cost exceeded the plan. Therefore, efficiency of the project is fair.

[22] The ex-ante evaluation defined the project period as 3 years and 6 months. However, the Agreement with the Cambodian government specified the period between January 10, 2006 and July 9, 2009. The judgement was based on the period in the Agreement.

3.4 Sustainability (Rating: ②)

As mentioned before, there was a continuity between TSC2 and TSC3 in terms of project purpose and activities. Since the assessment items overlap, the assessment data available at the time of the ex-post evaluation was used and analyzed to assess both phases integrally.

3.4.1 Policy and Political Commitment for the Sustainability of Project Effects

This project aimed at capacity building of the implementing agency for the management of irrigation systems and basin irrigation. It also aimed at the securing of O&M capacity for irrigation systems on the part of irrigation associations. There was no renewal of the country's development policy between project completion and the ex-post evaluation, and therefore no change in the policy landscape. In terms of legislation, sub-decrees regarding FWUC/FWUG and river basin management were passed respectively in 2015 in relation to the *Law on Water Resource Management* (formulated in 2007). The sub-decree on organizations for irrigation management defined the structure of FWUC committees, their roles, authority and management procedures, while the sub-decree on river basin management set out the structure of river basin management committees, their roles and concrete actions.

At the time of the ex-post evaluation, as mentioned above ("3.1.1 Consistency with the Development Plan of Cambodia), the policy prioritized effective O&M of irrigation systems. It further recognized improvement in the management of irrigation associations and the reinforcement of irrigation infrastructure management as policy challenges. The capacity building tackled in this project was necessary for the implementation of this policy and, as such, it is expected that there will be continuous government efforts in this field. The content of the sub-decree, on the other hand, suggests that there will be further legislation to delineate FWUC activities and river basin management. Based on the developmental policy and the contents of laws and regulations, it is considered that a conducive policy landscape has been secured for the sustainment of the project effects.

3.4.2 Institutional / Organizational Aspect for the Sustainability of Project Effects

For the implementing agency to sustain the capacity related to irrigation systems or river basin management, it is necessary that it, and especially that TSC responsible for training, secures the appropriate organizational environment. For the sustainment of the irrigated field area and the unit yield of rice at model sites, it is a prerequisite to have FWUC/FWUG function and to have irrigation canals appropriately managed. As mentioned above, FWUC make decisions on issues affecting the whole organization such as water distribution and irrigation service fee collection, while FWUG take on the actual O&M work for terminal canals.

The responsibilities for the O&M of irrigation infrastructure at the time of the ex-post evaluation were shared, in principle, as follows: (a) MOWRAM headquarters manages from the

water source of large and medium scale irrigation infrastructure (200 ha and above) to the secondary canals, (b) PDWRAM manages from the water source of small scale irrigation infrastructure (below 200ha) to the secondary canals, and (c) FWUC/FWUG manage tertiary and distribution canals.

At the planning phase of TSC2, TSC was a temporary unit created for the implementation of the project. By the project completion of TSC3, however, it had become an official department of the implementing agency. At the time of the ex-post evaluation, there had been no change in the organizational status of TSC. As described in the table below, the number of MOWRAM employees has remained stable since 2015, while that of TSC has increased. In the interviews with the implementing agency, it was reported that the personnel required to continue TSC training had been secured.

Table 19: Number of Staff in the Implementing Agency

	2015	2016	2017
MOWRAM	709 staff	843 staff	848 staff
in TSC*	35 staff	44 staff	43 staff
in PDWRAM	579 staff	553 staff	572 staff

Source: Answers from the questionnaire with the implementing agency
Note: *Including the staff in other departments serving as a lecturer

According to the explanation of the implementing agency, FWUC had been set up in all model sites by the time of the ex-post evaluation. During the site survey (at 4 model sites), it was also confirmed that each site had FWUC. At one site, there were regular FWUC meetings to make decisions on important issues (the approval and collection of irrigation service fees, canal cleaning, water distribution, etc.). At two sites, there were regular FWUC meetings, but the attendance of FWUC committee members was poor, which made decision making on important issues difficult. At one site, FWUC meetings were not held. According to the interviews with PDWRAM staff and beneficiary farmers, the changes of FWUC committee members whose attendance are poor does not take place as per procedure, and due to this difficulty, decision making on important issues tends to be prolonged. In cases where the arrangement of water distribution becomes disputed within FWUC, PDWRAM supports the reconciliation of differences among farmers. Some canal cleaning is planned by FWUC, but farmers' self-help efforts cover the majority of the cleanings of tertiary and distribution canals as well as small scale repair work. In the interviews with beneficiary farmers, it was reported that some repair work, for example on intake gates, was difficult for farmers to carry out by themselves.

The organizational system of TSC was put in place to sustain training within the implementing agency. On the other hand, FWUC are not very active in irrigation canal management and O&M and PDWRAM sometimes has to guide the water distribution arrangements. O&M work that is too difficult for farmers to do by themselves is also a challenge.

3.4.3 Technical Aspect for the Sustainability of Project Effects

In order that implementing agency staff and beneficiary farmers can sustain the skills obtained during the project, it is important that they have the opportunity to use their knowledge continuously, and that training and other support continue to be provided. The situation of the implementing agency staff and beneficiary farmers at the time of the ex-post evaluation is described below.

TSC staff: TSC staff enjoy an environment in which they carry out training based on the documents made in this project, while also maintaining their skill level through actual work (see Table 13). In an interview with TSC staff, it was pointed out that while they could maintain their skill levels through receiving lectures, the opportunities to gain new knowledge were dependent on the availability of donor support. There has been no issue in technical transfer, by the way, as there has been little staff change at TSC since the project.

MOWRAM headquarters and PDWRAM staff: As stated before, the training given by TSC encompasses irrigation planning to O&M. As such, opportunities are available for staff to learn a wide range of irrigation related skills in a continuous manner. In an interview with PDWRAM staff, it was reported that GIS skills, etc. are continually being used for the design of new irrigation systems and the formulation of operation and maintenance plans.

Beneficiary farmers: Of the total length of tertiary and distribution canals improved under TSC3, 90% was completed with the participation of farmers. It is considered, therefore, they have the technical capacity to conduct the O&M of tertiary and distribution canals. It was confirmed in the interviews with beneficiary farmers that they were engaged in O&M work (cleaning, small-scale repair work) themselves as and when necessary. During the project implementation, training was given to FWUC committee members regarding canal management, but TSC continues with training to reinforce FWUC/FWUG at model sites.

As the project provided a variety of machinery, during the ex-post evaluation, physical inspections of expensive equipment (unit price above USD 10,000) were conducted to discern whether or not there were mechanical problems. The result of the inspections is as follows.

Survey equipment: It was confirmed in the site field survey (TSC and PDWRAM in 3 provinces) that total stations[23] were used for training purposes at TSC and for the formulation of irrigation system plans at 2 PDWRAM. They can be repaired at the mechanical service center in Phnom Penh.

[23] Survey equipment that measures different topographical data such as distance, angles etc. simultaneously

Construction machinery/vehicles: The implementing agency explained that they knew the current location of construction machinery and vehicles provided by the project, and that the construction machinery was being used for construction work on other projects. There has been no problem finding spare parts or conducting maintenance for the construction machinery and vehicles provided by the project.

Total station

Considering the training activities carried out by TSC during and after the completion of the project, the actual work carried out by PDWRAM, and the repair work of farmers during the project, it is concluded that the necessary skills for O&M were obtained during the project, and that a favorable environment for the maintenance of technical capacity has been obtained.

3.4.4 Financial Aspect for the Sustainability of Project Effects

The requisite for the implementing agency to sustain capacity obtained in the irrigation sector is to secure by themselves a budget for the continuation of activities; especially for training at TSC. Furthermore, to sustain the irrigated field areas and the unit yield of rice at model sites, it is necessary to collect irrigation service fees from beneficiary farmers and for these to be allocated for maintenance costs.

The government budget allocated to the implementing agency has been stable since the completion of the project (see the table below). The budget allocation to TSC is on the rise and the budget for training activities is regularly secured. In addition, since 2015, some budget has been allocated to support FWUC/FWUG and for the O&M of canals. This suggests that budget is provided for activities that are not directly related to infrastructure investment.

Table 20: Government Budget for the Implementing Agency

Unit: US Dollar

	2014	2015	2016	2017
Rehabilitation and construction of irrigation systems	35million	33million	34million	41million
Establishment and strengthening of FWUC	0	1.6million	2.4million	1.4million
O&M of irrigation infrastructure	0	8.0million	9.0million	12.8million
Budget of TSC	50,000	62,500	75,000	87,500

Source: Answers for the questionnaire to the implementing agency

When verification took place with PDWRAM staff and FWUC committee members at 8 sites where the canal construction took place, it was found that irrigation service fees were collected at only two sites, Thomney and Roleang Chrey. Interviews with PDWRAM staff and FWUC

committee members revealed some of the reasons for the difficulties in fee collection: (a) Water supply is limited due to the lack of water during the dry season , (b) Farmers downstream who are affected by water shortages most severely, are not satisfied with the amount of water supply, (c) Beneficiary farmers refuse to pay the fee as other farmers use water without paying, and (d) Irrigation service fees cannot be decided as FWUC committee members do not attend meetings due to second jobs and seasonal migration. As the sub-decree on organizations for irrigation management does not have a clause on punishment for non-payment of irrigation service fees, it can be inferred that it is difficult to make FWUC enforce the collection of irrigation service fees. It was also said that the O&M work that requires a budget (application of lubricant oil to intake gates, for example) was impeded as fees were not collected.

Regarding TSC, its organizational budget is on the increase, and this situation allows TSC to continue capacity building in the irrigation sector. The budget for the O&M of irrigation canals is also being increased. More than half the model sites, however, have not been able to collect irrigation service fees. Therefore, it is considered that the rehabilitation of irrigation systems that requires a budget will be problematic in the medium and long term.

Some minor problems have been observed in terms of the organizational and the financial aspects. Therefore, sustainability of the project effects is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project aimed at promoting water management and securing agricultural productivity in and around the project sites in 6 provinces through capacity building of the implementing agency and irrigation associations. In Cambodia where the rice crop occupies 80% to 90% of the land area under cultivation, the purpose of this project was consistent with the country's policy and developmental needs which prioritized the development, maintenance and improvement of irrigation systems as well as the improvement of agricultural productivity. The project purpose was also consistent with Japan's aid policy, and therefore the relevance of this project is high. Before completion of the project, the implementing agency staff improved their capacity for irrigation system development and management as well as for extended irrigation management. Beneficiary farmers were organized, and their capacity for water management was reinforced. After project completion, TSC has continued to promote capacity building of implementing agency staff through training. PDWRAM, on the other hand, is maximizing its knowledge of the planning and designing of irrigation systems in order to apply for Japan's Grant Assistance for Grassroots Human Security Projects. At the time of the ex-post evaluation, the unit yield of rice among the beneficiary farmers at project sites was well maintained. The increase in agricultural income is contributing to improvements in farmers' livelihoods in general. As the realization of

project effects can be confirmed, it is concluded that the effectiveness and impact of this project are high. The actual project period was in accordance with the original plan. The project cost, however, exceeded the original plan, mainly due to the increase in the dispatch of experts. Efficiency, therefore, is fair. There was no indication of significant problems that would affect the sustainability in terms of policies and techniques. From the organizational and financial aspects, the activities of FWUC were not always successful and some FWUC faced difficulties in the collection of irrigation service fees. For these reasons, the sustainability of the project effects is concluded to be fair.

In light of the above, this project is evaluated to be satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the implementing agency

- Support for FWUC management

One of the reasons behind the difficulty in collecting irrigation fees at model sites is the inadequate functioning of FWUC, which hampers decision making on irrigation service fees. PDWRAM at model sites in 6 provinces should take following measures immediately for the resolution of this issue: (a) Send reminders to FWUC committee members who are frequently absent, or change members as required. (b) Support the proceedings of the meetings. (c) Monitor the decisions made by the committees. It is also recommended that the MOWRAM headquarters continue to supervise the improvement of FWUC committee management supported by PDWRAM.

- Remedial works and monitoring of water quantity

After the completion of the project, Damnak Ampil and Lum Hach faced a decrease in the quantity of irrigation water due to construction work on other irrigation infrastructure development projects. The unit yield of rice has been declining as a result. It is planned that remedial works are implemented in the future. To ensure the actual implementation of construction and the recovery of water quantity, it is desirable that the MOWRAM headquarters monitor the impact of construction work of other projects on the above-mentioned model sites.

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

Partnership with other projects and an agency to provide agriculture extension services

A precondition for the introduction of double cropping and new varieties is that the beneficiary farmers deepen their knowledge of advanced agricultural techniques such as variety selection,

fertilization, and pesticide application. While the implementing agency of this project was in charge of infrastructure development for irrigation, the Ministry of Agriculture, Forestry and Fisheries was responsible for agricultural extension services. Interviews with beneficiary farmers at the model sites showed that agriculture extension services provided through the local offices of the Ministry of Agriculture, Forestry and Fisheries, NGOs and JICA's technical cooperation project "Agriculture Productivity Promotion Project in West Tonle Sap" created the momentum for double cropping and the introduction of high-yield varieties. To promote the realization of project effects, it is desirable that coordination be sought with agricultural sector projects by JICA and other donors, and also with government agencies that provide agriculture extension services at both the project formation phase and the project implementation phase of irrigation projects. When an implementing agency for infrastructure development of irrigation is not responsible for agriculture extension services, it is highly recommended to consult and coordinate with other government agencies in charge of agriculture extension services from the project formation phase.

End