

Kingdom of Cambodia

Freshwater Aquaculture Improvement and Extension Project

External Evaluator: Machi KANEKO, Earth and Human Corporation

## **0. Summary**

This Project was planned when the Cambodian government was working for aquaculture promotion that would contribute to nutritional improvement and poverty reduction for rural residents. The four Southern provinces of the project target are located distant from major freshwater fisheries such as the Tonle Sap and the Mekong River. Also, in these rural areas, freshwater fisheries had not been common practice among small-scale farmers. Given these circumstances, the Project, which aimed at extending aquaculture and increasing freshwater-cultured fish production, is considered to have been consistent with policy objectives of the Cambodian government and development needs of the country.

While the number of small-scale aquaculture farmers has increased from 2,000 prior to the project implementation to 9,000, more than doubling of the project objective targeted 4,400. Furthermore, the aquaculture production in the target provinces has increased by 165% during the project implementation, achieving more than the overall goal indicator. Given that these outcomes have positively turned out as planned, effectiveness and impact of the Project are evaluated to be high.

In terms of the cost and period, the Project has been implemented as planned, and therefore, the efficiency is evaluated to be high.

The sustainability of the Project is considered to be high as the existing system and policies in the country are supportive. The ongoing national development policies emphasize that the aquaculture development shall play a crucial role to improve management, preservation and development of marine resources. Also, the target areas are suitable in extending aquaculture, given its natural environment, a food culture, the localities and a lifestyle of people. In fact, seed-producing farmers, trained by extension officers, have been transferring their technologies to small-scale farmers through sales of their seeds. This step-by-step technical transfer among farmers has been retained after the project completion, and therefore, the sustainability of the Project is considered to be high in terms of technical feasibility. As for financial sustainability, the ex-post evaluation study has observed seed-producing farmers have continued their activities, using their network. Thus, aquaculture has gained a solid ground for its technological extension, which allows Fisheries Administration (FiA) to manage at lower cost. Given these circumstances, the sustainability of the Project is considered to be high.

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

## 1. Project Description



Project Location  
(Target areas: Provinces of Kampong Speu, Kampot,  
Takeo and Prey Veng)



Lower left: An aquaculture pond of a small-scale farmer  
Upper right: Silver barb raised by the Project  
(good-tasting fish favored by local residents)

### 1.1 Background

In Kingdom of Cambodia (hereinafter referred to as “Cambodia”), approximately 80% of its labor force engage in the fishery, agriculture and forestry industry, and of these, people largely subsist on agriculture, mainly rice cultivation. Since 1995, although the country has attained self-sufficiency of rice, which is its staple food, the productivity is lower compared to that of neighboring countries. This is one of the factors that have trapped people in chronic poverty. To address poverty reduction and food security, the Cambodian government has been working for an increase and diversification of agricultural production.

Cambodia has the world’s fourth largest fisheries production in inland fisheries, and annual fish consumption per capita is as much as 52.4 kg (2007), which provides the Cambodian people with 75% of their animal protein intake. However, poor infrastructure has limited supply of marine products in rural areas distant from the Tonle Sap and the Mekong River. Accordingly, for these areas, low-input aquaculture development using rice field and seasonal temporary reservoirs has been increasingly considered to better fit the local needs. In the rural areas, having no experience of aquaculture, lack of the know-how and seeds has hindered farmers from starting the practice.

Given these backgrounds, the Cambodian government had requested Japan for technical cooperation to technologically improve small-scale aquaculture and promote its extension, targeting Southern four provinces (Prey Veng, Takeo, Kampong Speu, and Kampot). Upon this request, Japan International Cooperation Agency (JICA) had started “Freshwater Aquaculture Improvement and Extension Project<sup>1</sup>” to disseminate small-scale aquaculture. Started in February 2005, this five-year Project had been implemented by a counterpart agency, Fisheries Administration of the Ministry of Agriculture, Forestry and Fisheries of Cambodia.

<sup>1</sup> This technical cooperation project was implemented as a Request-responding project (Type A).

## 1.2 Project Outline

Overall Goal		Aquaculture production in target provinces is increased.
Project Purpose		Small-scale aquaculture technologies are extended largely in target provinces.
Outputs	Output 1	Seed producing farmers are trained among existing small-scale fish farmers by improving their aquaculture technologies.
	Output 2	Small-scale aquaculture technologies and its extension methods are improved.
	Output 3	Promotion of aquaculture activities that benefit poor farmers in the project area
	Output 4	An aquaculture extension network in rural area is developed.
Inputs		<p>Japan side:</p> <ol style="list-style-type: none"> <li>1. Dispatch of Experts 11 Japanese experts, 164.9MM in total 8 Third-country experts, 10.3MM in total (Indonesia, Vietnam, India and Nepal)</li> <li>2. 7 trainees for training in Japan</li> <li>3. 77 trainees for Third-country training</li> <li>4. 26 million yen for provision of equipment</li> <li>5. 20 million yen for facility development</li> </ol> <p>Cambodia side:</p> <ol style="list-style-type: none"> <li>1. Counterpart staffing (39 members at the time of a mid-term evaluation, and 37 at the time of a terminal evaluation)</li> <li>2. Land, facilities, project office, Bati seed production facility, local FiA office in the target provinces, and utilities</li> <li>3. Local cost and salaries for counterpart staff</li> </ol>
Project Cost		513 million yen
Cooperation period		February 2005 - February 2010
Implementing Agency		Fisheries Administration (FiA)
Cooperation Agencies in Japan		Saitama Prefecture Fisheries Laboratory at Research Center for Agriculture and Forestry Tokyo University of Marine Science and Technology
Related Project		Technical Cooperation Project: Technical Cooperation Project: Freshwater Aquaculture Improvement and Extension Project (Phase 2) (March 2011-February 2015)

## 1.3 Outline of the Terminal Evaluation

### 1.3.1 Achievement of Overall Goal

The attainment of the overall goal was assessed by an indicator that “aquaculture production of target provinces is increased by 1.5 times.” According to agricultural statistics provided by the Ministry of Agriculture, Forestry and Fisheries of Cambodia and FiA’s statistics, a terminal evaluation study revealed the indicator of the overall goal was achieved

during the Project implementation. Specifically, as indicated in Table 1 below, the aquaculture production by small-scale farmers in the four target provinces increased from 1,390 tons in 2004 prior to the project implementation to 2,294 tons in 2008. This is an increase of 165%, exceeding the 150% indicator set for the overall goal. In accordance with such positive project outcome, the number of aquaculture farmers has also been increasing. It is thus anticipated that the aquaculture production would be more likely to increase after 2009 onwards.

Table 1: Aquaculture production by small-scale farmers in 4 target provinces

(unit: ton)

Province Annual	Kampot	Kampong Speu	Prey Veng	Takeo	Total
2004	25	40	510	815	1,390
2005	50	110	600	800	1,560
2006	90	163	845	950	2,048
2007	114	208	850	1,000	2,172
2008	158	287	830	1,019	2,294

Source: Terminal Evaluation Report of this Project (December 2009)

### 1.3.2 Achievement of Project Objective

Attainment of the project purpose was assessed by an indicator that the number of small-scale fish farmers is increased from existing 2,000 households to 4,400 in the target four provinces. At the end of FY2008 when the Project was half implemented, about 6,000 households have already started aquaculture as a result of its effort to transfer the technique. This was largely made possible by a farmer-to-farmer training in which seed-producing farmers provide instructions to small-scale farmers. The number of aquaculture farmers at the time of project completion was estimated by aggregating the number of households participating in aquaculture training and that of households purchasing seeds from seed-producing farmers. It indicates that about 9,000 households practice aquaculture led by the project activities. This far exceeds the indicator targeting 4,400 households, and thereby the project purpose is considered to have already been achieved.

### 1.3.3 Recommendations

The following is proposed in terminal evaluation.

(1) Strengthening a network to extend aquaculture that would contribute to sustainable development

1) Technical development of seed-producing farmers participating in the network

Using their network, seed-producing farmers can develop their production techniques by

interchanging their parent fish or know-how. It is thus recommended experts and regional extension officers provide them with continuous support to enhance such alliance.

## 2) Supporting the farmers' network in expanding the marketing base for seed sales

The farmers' network needs to increase potential buyers by marketing seeds more strategically and by exchanging market information systematically including supply and demand trends by region and type of fish.

## (2) Ensuring monitoring of propagation-related activities in community fish refuges (CFRs)

With respect to propagation in CFRs, it requires monitoring activities of the Resource Management Committee such as stocking fish in CFRs. Monitoring should assess how such propagation in CFRs possibly affects people in the surrounding communities. By extracting the best practice out of 22 CFR sites provided by the Project, better CFR management shall be shared and practiced accordingly.

## (3) Documentation on farmer-to-farmer aquaculture extension system

One of the key factors that enabled rapid aquaculture extension is a farmer-to-farmer extension mechanism incorporated into the project design, which applied a three-step technology transfer. The process involved transferring techniques (1) from Japanese experts to extension officers, (2) from extension officers to seed-producing farmers, and (3) from seed-producing farmers to small-scale farmers. Thus techniques were handed down stepwise, with a geometrically increasing number of trained farmers. It is suggested the joint evaluation team keep a record of this successful experience of the Project so as to be utilized in other similar projects.

## **2. Outline of the Evaluation Study**

### **2.1 External Evaluator**

Machi KANEKO, Earth and Human Corporation

### **2.2 Duration of Evaluation Study**

The External Evaluator performed an evaluation study as follows in the course of this ex-post evaluation:

Duration of the Study: September 2012 - October 2013

Duration of the Field Study: November 30 - December 23, 2012 and May 7 - 25, 2013

### 3. Results of the Evaluation (Overall Rating: A<sup>2</sup>)

#### 3.1 Relevance (Rating: ③<sup>3</sup>)

##### 3.1.1 Relevance with the Development Plan of Cambodia

The Project was started when the Second Five-year Social and Economic Development Policy (2001-2005) was being implemented in Cambodia. In this policy framework, inland fisheries aquaculture using rice field and reservoirs was thought to be the key to increase fish production, and for that end it emphasized promotion of small-scale aquaculture in rural areas. In addition, freshwater fish is a ready available source of protein for the Cambodian people, which is in steady demand in the country. By using this resource, the Second Five-year Plan in Fisheries Sector (2001-2005) addressed an increase in income and improvement of health. Specifically, it targeted a 300% increase of the fish aquaculture production to meet the needs of animal protein and reduce poverty.

During the implementation of the Project through its completion, the National Strategic Development Plan (NSDP 2006-2010) had given priorities, among other things, in agricultural development, as well as an increase in agricultural production and productivity. Also, in the Rectangular Strategy which underpins the Cambodian basic development policies (agricultural development, infrastructure development, private sector growth and employment and human resource development), agricultural development constitutes one of the four sides of the strategic growth rectangles. It also emphasized fisheries, as a part of agricultural sector, needs sustainable development so that fish production can provide basic food, nutrition, income and livelihoods to people. In particular, aquaculture was considered to play a pivotal role, and therefore these policies outlined specific needs in aquaculture development, including culture ponds, rice field aquaculture, training, seed plant construction and seed-producing networking.

In the Fisheries Development Plan of Cambodia, given as the fisheries sector policy, its objectives are directed at poverty reduction, food security and sustainable and equitable use of natural resources. Within this policy framework, a strategic action plan specifies the following six key areas (1) development of policies and related laws, (2) reform of fishery rights, (3) propagation and stoking, (4) rural development tailored to localities, (5) improvement of livelihoods for poor families through sustainable use of natural resources and aquaculture promotion in rural areas, and (6) improvement of livelihoods for poor families through personnel training in postharvest treatment. Given that the Project supports rural small-scale, poor farmers in promoting their appropriate practice of aquaculture and

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<sup>2</sup> A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

<sup>3</sup> ③: High, ②: Fair, ①: Low

propagation in CFRs, its objectives are consistent with (3), (4) and (5) mentioned above.

Extending low-input aquaculture technologies, the Project aimed to contribute to nutritional improvement and better livelihoods of poor residents in rural areas, and therefore it has been considered that it was consistent with the national development policies and sectorial development plans of the Cambodian government from its planning phase to completion. The ex-post evaluation study confirmed the country has still retained these objectives, and therefore the Project is considered to consistently support the ongoing Cambodian national policies.

### 3.1.2 Relevance with the Development Needs of Myanmar

Distant from major freshwater fisheries such as the Tonle Sap and the Mekong River, the target four Southern provinces had a limited catch and supply of natural fish. Also, the freshwater fisheries had been limited among small-scale farmers in rural areas, unable to supply an adequate amount of freshwater fish. Given low agricultural productivity due to droughts and floods, moreover, the Cambodian government had recognized inland fisheries and its extension as alternative sources of cash income and animal protein for people. It strongly desired to obtain assistance in coping with these situations, and the development needs were increasing at the time of the project planning.

Furthermore, the ex-post evaluation study confirmed fisheries and aquaculture production is increasing every year, reaching 610,000 tons in 2011 after the project completion. A catch from inland fisheries accounts for as much as 450,000 tons of the total fisheries production, leading to the world's fourth largest fish production of its kind. In Cambodia, people take 82% of animal protein from fish and processed marine products, with an annual per capita fish consumption of 52.4 kg. Most of such consumption depends on freshwater fish, which is said to represent the world's highest consumption of its kind.

Aquaculture production has been largely increased in recent years, almost doubling in 2011 compared to 2007. This reflects a rapidly growing demand of the aquaculture fish to make up for a shortage of natural fish, mainly caused by a population growth in rural areas.

The following Table 2 illustrates a change in fisheries and aquaculture production.

Table 2: A change in fisheries and aquaculture production

(unit: ton)

	Fisheries and aquaculture production	Inland fisheries catch Sea fishery catch	Aquaculture production	Aquaculture production
2007	493,760	395,000	63,000	35,260
2008	470,100	365,000	66,000	39,100
2009	515,080	390,000	75,000	50,080
2010	550,000	405,000	85,000	60,001
2011	608,000	445,000	91,000	72,000
2011/2007	123%	127%	144%	204%

Source: Fisheries Administration

Targeting rural small-scale farmers who have little experience in inland fisheries, the Project was designed to widely extend freshwater fish aquaculture. From the beginning of the Project through its completion, these areas had such development needs to be responded. In the Project target areas, small-scale farmers were compelled to live on rice cropping where irrigation system was poorly developed. Their rain-fed cultivation hinders increasing productivity, resulting in chronic poverty of these farmers. Given this situation, aquaculture promotion through the Project expected to contribute to nutritional improvement and income generation, and thereby it has been consistent with needs of small-scale farmers, who were to be final beneficiaries.

One of the emerging issues in rural areas in Cambodia is a population increase, and this has led to the necessity of diversifying income sources other than rice farming as well as securing stable food production and supply. Since aquaculture in rural areas is expected to have positive effects –nutritional improvement and generation of income--the need for aquaculture is growing even more after the completion of the Project. Moreover, the Project has successfully developed a method of extending low-input aquaculture among a large number of farmers, using their rice fields and seasonal temporary reservoirs. Given these circumstances, the Project is evaluated to be relevant with the development needs of Cambodia at the time of the ex-post evaluation.

### 3.1.3 Relevance with Japan's ODA Policy

The Project was planned in accordance with the framework of Japan's "Country Assistance Policies for Cambodia (February 2002). To achieve sustainable economic growth and a stable society in Cambodia, it highlights an importance of "agricultural and rural development, and agricultural production increase." As a part of its efforts to realize such objectives, the Policies aim to develop technologies of freshwater aquaculture.

Also, in JICA Country Assistance Strategy for Cambodia, a "promotion of the livestock and fisheries industries" is considered to be one of the development priorities aimed at "Agriculture and Rural Development."

In light of the above, this project has been highly relevant with the country's development plan, development needs, as well as Japan's ODA policy, therefore its relevance is high.

### 3.2 Effectiveness and Impact<sup>4</sup> (Rating: ③)

#### 3.2.1 Effectiveness

##### 3.2.1.1 Project Output

The terminal evaluation study suggests that the outputs, purposes and overall goal of the Project had been mostly achieved. Therefore, the ex-post evaluation study has assessed the degree of attainment of respective output as much as possible.

##### 1) Output 1

Seed producing farmers are trained among existing small-scale fish farmers by improving their aquaculture technologies.

(Indicator) 20 seed-producing farmers are developed and produce seeds by themselves.

(Degree of attainment) Upon the project completion, 48 farmers engage in seed production, more than doubling of the target of 20 farmers, and therefore the Output 1 is achieved.

This Project had set four pilot communes in the respective four target provinces. Then, one candidate seed-producing farmer was carefully selected from each commune every year (a total of 48 farmers, given 4 provinces x 4 communes = 16 farmers and 16 farmers/year x 3 years = 48 farmers). The Project provided technical training in addition to necessary equipment of fish hatcheries (about 500US\$). As a result, by 2009, 48 farmers have been able to operate seed production, using their own financial resources and learned know-how, as indicated in Table 5. However, it should be noted, at the time of the project planning, that 11 farmers had already engaged in seed production, and that existing 2,000 farmers had been practicing aquaculture. Hence, the Project supported these farmers to assume a leading role in farmer-to-farmer training.

Table 3: Change in the number of seed-producing farmers in the target 4 provinces

(Unit: household)

Province	During the project implementation				After the project completion	
	2006	2007	2008	2009	2010	2011
Takeo	4	7	10	12	13	17
Kampong Speu	4	7	10	12	14	17
Kampot	4	8	12	12	12	14
Prey Veng	4	8	12	12	13	16
Total	16	30	44	48	52	64
Number of existing seed-producing farmers	11	11	11	11	11	11
Total	27	41	55	59	63	75

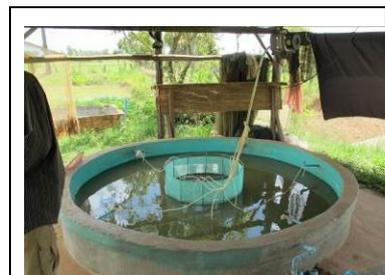
Source: The Terminal Evaluation Report of this Project (2006-2009), Reference provided by FiA (2010-2011)

<sup>4</sup> Effectiveness should be judged in consideration of impact to determine a rating.

Selection and training of seed-producing farmers were completed in 2009, and afterwards the Project worked particularly on developing and strengthening an aquaculture extension network among seed-producing farmers. As a result, in the target four provinces where farmers used to have little aquaculture experience, seed production increased from 1.55 million fish in 2006 right after the project launch to 7.2 million (a total of 37 million country-wide) in 2008.

The ex-post evaluation study assessed the current situations in the four target provinces about three years after the project completion, and found FiA has continued a training for seed-producing farmers, despite on a smaller scale compared to during the project implementation period. Also, the number of seed-producing farmers has increased since the project completion. More specifically, as mentioned in Table 3 above, the number of seed-producing farmers increased from 59 in 2009 (inclusive of existing 11 farmers and 48 new farmers trained by the Project) to 63 in 2010, and to 75 in 2011 subsequently. This is underpinned by a continuous support provided by FiA for seed-producing farmers after the project completion. Also in the target areas the demand for seed has outreached the production, and thus FiA anticipates there would be a growing number of core farmers who wish to start seed production. An on-site interview revealed most of all the seed-producing farmers have been expanding their fish hatcheries and aquaculture facilities at their own expenses. Given these situations, seed productivity would be further increased.

In the light of the above, it can be said that the Output 1 has been achieved at the time of the project completion. Also, the ex-post evaluation study has observed the amount of seed product marketed in the target areas has been increased. This is because aquaculture technologies have become widely available in the target rural areas in a post-project period. Moreover, an increasing number of farmers have started seed production, while existing seed-producing farmers have further improved their productivity (through



A seed-producing farmer in Kampot  
A fish hatchery provided by the Project for artificial hatching by flowing water



Mrigal's eggs which are about to hatch (about 200,000 fish are incubated: photographed in May, 2013)



Aquaculture pond of a seed-producing farmer in Takeo  
(The farmer's own investment has expanded 6 ponds in 2005 to 16 in 2012.)



Juvenile fish of Silver barb  
Generally beginning in May, the production of juvenile fish starts in the rainy season, depending on the rainfall.

self-financed improvement of facilities, etc.).

According to FiA, it plans to expand the project outputs in and out of the target provinces, covering the rural areas. Under the “Framework for Strategic Plan in Fisheries in Cambodia from 2010 to 2019,” revealed by FiA most recently, a target is set to achieve seed production of 150 million fish in 2015, increasing up to 250 million fish in 2019. In addition, in order to duplicate the project outputs countrywide, a JICA project, “Freshwater Aquaculture Improvement and Extension Project Phase II” is underway in other three Northern provinces. Other international agencies such as EU have provided assistance in developing seed-producing farmers.

## 2) Output 2

Small-scale aquaculture technologies and its extension methods are improved.  
 (Indicator) Small-scale aquaculture technologies suitable for local conditions are developed and its extension materials are prepared.  
 (Degree of attainment) The technologies have been improved, developed into instruction materials to be used in training. These technologies are widely applied, and therefore the Output 2 is achieved.

The Project had mainly worked for technological improvement in the first half term of the project period. It includes development of aquaculture (grow out) techniques of small-scale farmers, techniques of seed-producing farmers and propagation techniques in CFRs in each community. They have been organized in a booklet, a manual, posters and videotapes so as to be utilized in technical instruction. Distributed by extension officers and seed-producing farmers to small-scale aquaculture farmers, these materials have been a useful tool in extending aquaculture technologies.

The terminal evaluation study revealed improved technologies have been widely accepted and practiced among farmers, and that they have positive effects on a nutritional intake and income generation.

The on-site interview during the ex-post evaluation study observed instruction materials provided by the Project have been still posted and used in a training of farmers in small-scale aquaculture. Also, a farmer-to-farmer technology transfer has come into effect where some

seed-producing farmers trained in the Project have become an instructor; they teach incubation for core farmers of new starters as well as seed-producing farmers trying



Seed-producing farmers use these instruction materials in training small-scale aquaculture farmers.



A signboard indicating a seed producer trained by the Project

propagation of new fish species. Such training for technology transfer is supported by the government and international development agencies.

In order to extend small-scale aquaculture, the Project has incorporated a farmer-to-farmer training through a three-step technology transfer. The process involves transferring aquaculture technologies (1) from Japanese experts to extension officers, (2) from extension officers to seed-producing farmers, and (3) from seed-producing farmers to small-scale farmers. Thus the technologies were effectively handed down stepwise, with a geometrically increasing number of trained farmers. As mentioned above, the outcome of this ex-post on-site study indicates a farmer-to-farmer technology transfer is gradually developing, given that experienced seed-producing farmers are playing a leading role to train farmers starting seed production and those farmers incubating new fish species. The successful experience is underpinned by the fact that extension of small-scale aquaculture technologies has increased farmers' profit from seed production. The beneficiary survey revealed the number of households which gained more income than three years ago was 9 out of 15, with 4 households experienced no change. However, in terms of their livelihoods, 14 out of 15 households have felt a positive change. Moreover, 14 out of 15 households have invested in their seed production after the project completion, with an average of 5 million riels (about 1300US\$). All of the farmers surveyed said they wished to continue their seed production. Thus, these survey results suggest an increase in profit from seed production is an incentive for those farmers to continue aquaculture.

In light of the above, the Output 2 has been achieved. After the project completion, the instruction materials created during the project have been used in extending aquaculture technologies, and thus the project output is considered to be sustainable or even be developing.

### 3) Output 3

Aquaculture-related activities to benefit the poor farmers are promoted.  
 (Indicator) Stock enhancement activities are undertaken in 20 community fish refuges  
 (Degree of attainment) Cultivation activities carried out in 22 shared ponds in FY2009, the final fiscal year of the Project, and at project end Output 3 has been achieved.

As shown in Table 5, in the Project, as a general rule one village is selected from each of the four target provinces every year, and by FY2009 shared ponds were installed at 22 sites, shared pond management committees were established, construction carried out of link canals to rice paddies, stocking of seeds, fishing resource management awareness achieved through shared resources, and guidance performed on patrol activities by residents groups. Furthermore, up until project completion these activities were being continued on a voluntary basis by residents groups, with the management committee at its center, and fisheries resource management activities for shared ponds was taking root.



Takeo province shared pond

In addition, the goal of the shared pond activities of this Project outlined below are for fish in the existing ponds to be released and cultivated, then enter into rice paddies through the fish ladder and be harvested by individual farmers who cannot own their own ponds in order that they can benefit from the effects of aquaculture. Use the existing man-made ponds and natural

ponds of the floodplain

- ✓ Stocking native fish
- ✓ Connecting the shared pond with the fish ladder and rice paddy
- ✓ Farmers harvest with light fishing gear at the waterway and rice paddy

In addition, a management committee was set up for shared pond management, (1) fish ladder service and maintenance, (2) stocking of native fish, and (3), along with management of fishing prohibition, resident educational activities are being carried out to ensure adherence to the rules of fishing prohibition times, fishing prohibited areas, prohibition on particular fishing gear, prohibition on discarded garbage etc. The committee activities are voluntary, but because the majority of rule violations are committed not by locals but by outsiders from other regions and villages, the awareness that monitoring activities are carried out to protect the property of the village acts as an incentive.

Confirmation was established for the FiA and visits to six shared pond locations as well as public hearings with the community-based management committees were carried out during

Table 5: The number of established shared ponds in target provinces

Fiscal Years	The number of established shared ponds
2005	4
2006	4
2007	6 (3 locations collaborating with WFP)
2008	4
2009	4
Total	22

Source: Terminal Evaluation Report of this Project

the ex-post evaluation. As a result, as self-management at each shared pond is continuing to be carried out and information such as the management rules for local shared ponds are becoming known. Consequently, the use of prohibited fishing gear and fishing at prohibited times has almost completely ceased. In addition, one effect of the installed shared ponds that residents point out is that the amount of fish caught in paddy fields has increased significantly and the fish flowing into the paddy from the shared pond has helped their household finances. Furthermore, being able to rely on the shared fish pond at times of food scarcity brought about by poverty and so on has become reassuring for the whole village, not only the poor. On the other hand, they have not reached the point of purchasing new seeds and supplementing stock.

As for the spread of shared ponds, the FiA sought to expand educational activities based on the "One commune, one community fish refuge" concept nationwide and, with a degree of support from NGOs and donors, by the end of 2008 share ponds were established in 207 locations. At the time of this ex-post evaluation, a policy of effective and sustainable shared pond expansion is being continued and the "The Strategic Planning Framework for Fisheries 2010-2019," using the reference value of 2009 (235 places), set a numerical target of 1,200 locations by 2019.

To conclude, this Project established shared pond management committees in 22 target villages, resource management activities of these shared ponds have been carried out in each village as community-based shared pond business, therefore it is determined that Output 3 has been achieved upon project completion. In addition, at the terminal evaluation carried out three years following the end of the project, community-based management activities for the shared ponds developed in the Project are ongoing. Furthermore, at the national level, in accord with the policies of the government, effective and sustainable expansion of shared ponds will continue into the future.

#### 4) Output 4

An aquaculture extension network in rural area is developed.

(Indicators)

- 4-1: Seed producing farmers conduct farmer to farmer training at least once a year by their initiative.
- 4-2: Meetings of the network in each target province are held 3 times a year.
- 4-3: Joint meeting of the network for all target provinces is held at least once a year.

(Degree of attainment) The three indicators above were all achieved by FY2008 and it has been confirmed at the time of project completion that activities have continued to be carried out in FY2009.

Number of participants in farmers training (Seed producing farmers -> small-scale aquaculture farmers)

For Indicator 4-1, an aquaculture dispersal network consisting of 48 seed producing farmers who were selected and trained by the Project plus 11 existing farmers that had engaged in seed production since before project launch has been established in each province. In addition, as shown in Table 6 below, in FY2008 these network farmers carried out aquaculture training 147 times for a total of 3,608 small-scale farmers. This equals to an average of 2.5 times for each seed producing farmer, one time higher than the target, and these activities continued in FY2009.



At this "training", the breeding methods were explained to farmers with a high potential of purchasing seeds and ultimately the purchase of seeds is encouraged. It has been confirmed by concerned parties through interviews carried out at terminal evaluation that since expansion of the customer base can be achieved effectively, seedling production farmers have been actively conducting business promotion activities in this group training format, and have implemented "original" training not related to the Project.

Table 6: Estimates of the number of farmers who attended aquaculture training or have been practicing aquaculture in the four project target provinces.

(Unit: household)

		Number of trainees		Number of farmers practicing aquaculture
		Aquaculture basic training (led by FiA diffusion workers)	Farmer to farmer aquaculture training led by seed farmers	
During the Project	2005	640		576
	2006	640	479	1,007
	2007	640	960	1,440
	2008		3,608	3,052
	2009		3,600	2,916
	Total	1,920	8,647	8,991
After project completion	2010	-	1,480	-
	2011	-	680	-
	Total	-	10,807	-

Source: The Terminal Evaluation Report of this Project (20052009), Reference provided by FiA (20102011)

Note: The number of farmers practicing aquaculture is calculated as "the number of trainees × practice rate (90 ~ 100%) × retention rate (90%)". The retention rate is set as 90% since the percentage of farmers that continue aquaculture one year after taking a training course was between 94% and 100% according to results of a sample survey carried out by provincial FiA extension officers..

In the ex-post evaluation study, the number of small-scale farmers who participated in farmer to farmer aquaculture training has increased and, as shown in Table 6 above, the total number of students was more than 10,000 by 2011. In addition, during project implementation in 2008 and 2009, there was easy access for each seed farmer at group

training and the number of participants rapidly increased with farmers who desire an immediate start to / are capable of starting aquaculture gathering together. However, it is postulated that because farmers usually make a decision only after confirming the success of other preceding farmers and prepared farmers have been entering in stages, actual aquaculture participation has been increasing gradually. As it is difficult to grasp the exact number of seed farmers who attended the training carried out for new aquaculture farmers, the data of the 2010 and 2011 group training quoted in table 6 is the number available at FiA.

In addition, seed farmers possessing high technology, with the help of NGOs or the government, also visit other provinces as lecturers for TOT (Training of Trainer) and provided guidance in incubation methods. By the end of the Project, four farmers from Kampot province, two farmers from Prey Veng province and 15 farmers from Takeo province had served in lecturer roles for TOT.

#### Number of seed producing farmer network meetings

With regards to Indicator 4-2, the aquaculture extension network meetings were set up in each province and have been held regularly on an almost quarterly basis in all provinces. In FY2008 they were held three times in each province with a total of 193 participants. Network meetings in each province regularized and carried out in the following year FY2009.

Each member exchanges views on the three main points of seed production technology, seed sale supply and demand, and financing. It has been identified at the end of the Project that these meetings act as an opportunity for members to search for clues in solving common problems that farmers face such as technical improvement, stable management and facility expansion.

In the ex-post evaluation survey it has been confirmed that the seed producers network in each province is working, and extension workers of the FiA are also actively involved. For example, the Takeo province network has held a meeting once a month and is also focusing on lending to members. The Kampot province network took advantage of mobile phones to exchange information and implemented joint purchase of chemicals and equipment, and an opportunity for everyone to gather directly occurs about once a year.

As for Indicator 4-3, all four province network meetings were held once each in FY2008 and FY2009 and more than 70 farmers participated each time, but after the completion of the Project there has not been an opportunity for the all four provinces network to meet.

#### Aquaculture activities in a school

One part of the activities planned in Output 4 is, in addition to the three indicators described above, "the introduction of aquaculture as educational activities in schools." In the Project, 1 school was selected every year starting from 2006 and, as a joint venture,

support for the introduction of aquaculture activities into four elementary schools, 10 junior high schools and five high schools was carried out. As a result, other than just being able to eat the fish that they harvested, it has been confirmed that school management has benefited from the aquaculture business, it has acted as a public relations activity for promoting understanding of aquaculture with those related to the schools (children / students, parents, relatives, neighbors, etc.) and it has been incorporated into the curriculum.

In the ex-post evaluation we visited the four schools mentioned above, however, at some, activities had ceased completely. The reasons given for this by teachers is that managing the ponds by school staff alone is a large burden and as there are no clear rules between the school and local residents, there are large numbers of people who take fish without permission. They also pointed out the difficulty of balancing school education with water management for a rain dependent pond.

From the above it can be said that Output 4 has been somewhat achieved by the time of project completion. Further, it has been confirmed that the seed producers' network was still generally being maintained even after project completion. However, differences could be seen in the activities of each province. As for farmer to farmer training, the transfer of technology from seed producers to small-scale farmers is continuing in each province and it is determined that training will continue in order to secure customers for seeds in the future.

### 3.2.1.2 Achievement of Project Objectives

Project objective: Small-scale aquaculture technologies are extended largely in target provinces.

(Indicator) In the Project's four target provinces, small-scale farmers increased to 4,400 from the existing 2,000.

(Degree of attainment) It is estimated that at the end of the Project about 9,000 small-scale farmers were conducting aquaculture in the target provinces (more than double the target) therefore the project objective is considered to have been achieved.

As mentioned earlier in Output 4 the total number of farmers who participated in aquaculture training carried out by seed production farmers had reached 8,647 by the end of the Project. From the monitoring results of Province extension workers, the percentage of participating farmers that actually implemented aquaculture (practicing rate) was 90-100% and the percentage of farmers who were continuing aquaculture one year after beginning (retention rate) was about 90%. If we multiply this by the number of farmers who participate, we can estimate the number of small scale farmers implementing aquaculture and

the figures are shown in the table below. It is estimated that there were 8,991 by the project end.

Table 7: The number of small-scale farmers carrying out aquaculture in the Project's four target provinces (estimated from aquaculture trainee numbers)

(Unit: household)

	2005	2006	2007	2008	2009
Aquaculture basic training					
Number of trainees	640	640	640		
Number of farmers practicing aquaculture	100%	100%	100%		
Retention rate after one year	90%	90%	90%		
Number of farmers practicing aquaculture	576	576	576		
Farmer to farmer aquaculture training					
Number of trainees		479	960	3,608	3,240
Number of farmers practicing aquaculture		100%	100%	94%	90%
Retention rate after one year		90%	90%	90%	90%
Number of farmers practicing aquaculture		431	864	3,052	2,916
Total	576	1,007	1,440	3,052	2,916
Total	576	1,583	3,023	6,075	8,991

Source: Terminal Evaluation Report of this Project

Table 8 below shows the changes in the number of customers sold seeds grown by seed producing farmers of the Project. In 2008, 9,525 households were buying seeds from seed producing farmers. Sales equal to or greater than this had been expected for 2009. In addition, at the start of the Project 70% of farmers in the target commune had purchased cultivated seeds from government seed production facilities, but in 2007, 70% of farmers were now buying from regional seed producers. In 2009 the ratio achieved was 100%.

In light of the above, the estimated number of small-scale aquaculture farmers in the region and number of seed sales customers are both about 9,000 households and it can be suggested that

Table 8: The number of customers sold seeds from seed producing farmers.

(Unit: household)

	2006	2007	2008
Takeo	768	1,036	3,176
Kampong Speu	165	651	1,210
Kampot	88	1,575	1,788
Prey Veng	316	1,488	3,348
Total	1,337	4,750	9,525

Source: Evaluation report at the end of this Project

these 9,000 households implemented and continued aquaculture due to the motivation of the project activities. In addition, we suggest that this number of 9,000 small scale farmers conducting aquaculture in the target provinces is equal to about double the project objective of 4,400 and thus we judge that the project objective has been achieved.

The number of small-scale aquaculture farmers and number of seed producing farmer seed sales customers after the completion of the Project are as shown in Output 4 and, as mentioned earlier, because the number of trainees undertaking farmer to farmer training has increased to 2,000 by the time of project completion it can be expected that small aquaculture farms have also increased further. In addition, according to the results of a beneficiary survey carried out on seed producers (15 households), 9 out of 15 households answered that, compared with three years ago, farmers engaged in aquaculture throughout residential areas have been growing in number. In regards to life improvements for their family, 14 out of 15 households answered that it had improved compared to three years ago and this has become one of the factors that increases the ambition of seed producing farmers. In addition, according to the results of a beneficiary survey of small-scale aquaculture farmers (80 households), in response to the question, "compared to before you started aquaculture, has the amount of fish you eat increased?", more than 90% answered that it had increased and it can be determined that the spread of farming technology has led to the improvements in animal protein intake. The factors that led to this smooth diffusion of aquaculture are listed in Table 9.

It is determined from the above that each indicator related to the project objective has been largely achieved. In addition, from the fact that even at the end of the Project the number of participants in farmer to farmer aquaculture training are increasing, it can be further determined that small-scale aquaculture farmers are also growing in number.

Table 9: Factors that promoted the manifested results and characteristics of small-scale freshwater aquaculture that has been established in this Project

	Features of this Project	Promotional factor
(1)	Use of farmers own reservoir ponds etc.: The target areas have always been dependent on rainwater for agricultural water and domestic water use and so many farmers maintained their own reservoir ponds. In this Project, in order to reduce the initial investment burden to farmers, aquaculture was carried out using rice paddies or reservoir ponds.	⇒ Inexpensive initial investment, the use of regional characteristics
(2)	Abundant fish species and ingenuity of feed: In addition to using livestock manure as fertilizer for generating plankton and so on in breeding water, materials such as rice bran leftovers that are readily available to rice farmers are also used as feed. Therefore for the fish species, plankton, plants and omnivorous fish that do not require a special diet were used and there is the potential for four species to be raised simultaneously. In addition, Cambodia is rich in fish species that live in freshwater and this has nurtured a food culture that prefers freshwater fish. Furthermore, many species that require certain technology for breeding, the possibility of creating differences in the technological capabilities of aquaculture farms and seed growers and competition from neighboring farmers over the same species are factors to avoid.	⇒ Utilization of unused resources, spread of application of simple techniques, abundant fish species (Reference Information: the parent fish of tilapia, that are cultured in abundance in Africa and so on, do not prey on fry and are a fish species that is easy for natural breeding, meaning there is the possibility that the need for seed producing farmers will decrease over time)
(3)	Seasonal Freshwater aquaculture : Instead of all year round, the freshwater aquaculture that is planned to be spread in this Project will have a season of about nine months and will rely on rainwater accumulated in the rainy season. More specifically, fish will be stocked in the rainy season (June-July), fish grown from October to November gradually harvested, then, when the water level drops during the dry season of March-April, a pump or the like will be used to drain water from the pond and harvest all the fish that may have remained. For this reason, in order to carry out aquaculture in the following year, it is necessary to purchase seeds. Further, for completely draining water, quality management is also facilitated.	⇒ Establishment of seed production and an aquaculture cycle utilizing the characteristics of the region / natural environment
(4)	Aquaculture for self-consumption: Rural households in Cambodia endeavor to be self-sufficient in fish, their day-to-day staple, as much as possible and make up for any lack therein by purchasing fish at the local market. In this Project, the primary intention was for self-consumption and, if there happened to be a surplus, these fish could be sold and become an additional income source. (In the beneficiary survey carried out for ex-post evaluation, 80 small-scale aquaculture farmers' households were asked why they started aquaculture. 71% stated it was so their family could eat and 23% stated that it was for additional income.)	⇒ The height of ongoing satisfaction and motivation of farmers for being self-sufficient in fish
(5)	Food culture that prefers freshwater fish: The average per capita annual fish consumption of Cambodian people is 52.8kg, one of the top levels in the world. In addition, most of the countries with high fish consumption are a production center of seafood, such as Japan, but when it comes to the heart of freshwater fish consumption, Cambodia is the largest. Furthermore, in country comparison (FAO2009) in terms of the proportion of fish as ingested animal protein, Cambodia stands at 68.7%, which is higher than even Thailand (34.9%), Vietnam (38.3%), and Japan (39.9%). The context that livestock production is scarce should also be mentioned.	⇒ Consistent with food culture, there is a lack of animal protein other than fish (beef, pork, chicken, etc.) and there is no competition from marine fish.

(6)	The presence of existing aquaculture farmers: There were 2,000 farmers carrying out aquaculture in the four provinces before the Project began.	⇒ Certain understandings of aquaculture fish production (such as spreading farming culture in areas that rely only on natural fish is difficult)
(7)	Specifics of economic benefits to seed producing farmers: During the implementation period of this Project, seed producing farmers could confirm that aquaculture farmers had increased in the target areas and that sales revenue was attainable, so it was possible to make material for future predictions. In addition, since the population density, and household density of the target areas are higher than the national average, customer access is easy. In response to this information and experience, as well as the proactive guidance and support from seed producing farmers to small-scale farmers who are their customers, investments will be carried out for facility expansion aiming to increase seed production which will additionally lead to an increase in small scale farmers.	⇒ Aquaculture diffusion based around seed producing farmers

### 3.2.2 Impact

#### 3.2.2.1 Achievement of Overall Goal

In the target provinces, aquaculture production volume increases.  
 (Indicator) Aquaculture production in target provinces will increase 1.5 times.  
 (Achievement) In comparison with 2004, before the Project started, aquaculture production by small farmers was 1.65 times higher in the 4 target provinces in 2008, so it can be said that the overall goal has been achieved.

At the time of terminal evaluation, it was confirmed that during the project implementation period, aquaculture production in the target provinces achieved the overall goal indicator of a 1.5 times increase according to the statistics of the Fisheries Administration and the statistics of the Cambodia Ministry of Agriculture, Forestry and Fisheries.

In addition, in Table 10 below, at the time of terminal evaluation, figures confirmed for 2004 to 2008 were added to figures confirmed for 2011 to 2009 and consolidated to show the transition of aquaculture production in the four provinces over about eight years. From this table it can be seen that the amount of production was 1,390 tons in 2004, increased to 2,294 tons in 2008 (at the time of terminal evaluation), and can be assumed to have been increasing steadily since then.

Table 10: Trends in aquaculture production by small-scale farmers in the four target provinces

(unit: ton)

	Kampot	Kampong Speu	Prey Veng	Takeo	All four provinces
2004	25	40	510	815	1,390
2005	50	110	600	800	1,560
2006	90	163	845	950	2,048
2007	114	208	850	1,000	2,172
2008	158	287	830	1,019	2,294
2009	500	2,500	1,800	3,000	7,800
2010	520	3,000	2,500	3,900	9,920
2011	1,185	3,860	3,500	3,690	12,235

Source: Fisheries Administration

It can also be determined that the indicators for the overall goal were achieved during the project period and that, even after completion of the Project, the effects are continuing to be maintained.

### 3.2.2.2 Other Impacts

#### (1) Impact on the natural environment

Since the aquaculture method subject to being spread in this Project is performed using ponds that accumulate rainwater in the rainy season in order to ensure valuable domestic water for the dry season, the possibility of water contamination due to aquaculture or contaminated water being drained into surrounding rivers is extremely small. Further, due to the use of rice bran and manure (a by-product of agriculture) for fertilization material and bait, unlike high-value aquaculture there is no burden on other productive activities due to issues such as competition over bait materials. Moreover, the target species<sup>5</sup> included exotic species that do not originate in the Mekong river system but at the time of introduction it can be considered that all had previously been disseminated and naturalized and, as fish that feed on detritus and plankton, their feeding habits are mild so even if they were to escape to natural waters the impact on biodiversity and fish fauna in the region's river system would not be large. In addition, appropriate attention has been given to ecosystems, ensuring the release of only native species for harvesting in the open waters of rice paddies through shared pond activities.

#### (2) Land acquisition and resettlement

As aquaculture promotion was carried out using existing rice paddies and naturally occurring seasonal reservoir ponds, no resettlement or land acquisition has been implemented.

<sup>5</sup> The five fish species that are subject to aquaculture diffusion in this Project are the native Silver Barb, along with Nile Tilapia, Common Carp, Silver Carp and Mrigal Carp which had already been introduced in the past and were established as general target aquaculture fish.

### (3) Other indirect effects

#### (1) Gender

Although the majority of students for farmer to farmer aquaculture training were the male heads of the household, along with the general increase in the number of participants, at project completion it has been confirmed that the number of participating women has also increased.

In addition, as men are often away from home for prolonged periods of time due to working away from home and managing side businesses, producing feed and water management is often actually carried out by women. When making field visits to small scale farms at the time of ex-post evaluation, women were often seen engaging in farming activities on a day to day basis.

Furthermore, even with seed producing farmers, many women are actively taking lead roles and there is a high hope for the entry of women into the aquaculture field. Women have in particular served as leaders in the Kampot province aquaculture network, which has made seed loans (interest-free) to poor farmers who can't purchase seeds with cash. This initiative, which has not been implemented in other provincial networks, is the brainchild of women leaders.

#### (2) Implementation of Phase 2 by utilizing the results of the Phase 1

The approach applied in this Project of farmer to farmer extension with seed producing farmers at its core, saw a rapid spread of aquaculture technology among farmers in the target villages. As the Government of Cambodia highly rated this Project's results, they have further requested the "Freshwater Aquaculture Improvement and Extension Project Phase 2" targeting high poverty northwestern areas.

In response to this, JICA sent a detailed planning study team twice, in May and September of 2012, and after a series of discussions with the Cambodian government, including the FiA, the framework was decided that in the three target provinces of Pursat, Battambang and Siem Reap (1) Seed production and aquaculture would be improved, (2) capacity building carried out for local administrations to extend aquaculture, (3) training implemented for seed producing farmers, (4) small aquaculture activity developed, and (5) activities performed that will contribute to the strengthening and broadening of a seed producing farmers network. Based on this framework, a project with a planned period of four years aiming to achieve increased production of small-scale aquaculture was determined. At the time of this ex-post evaluation, it had been put into practice since mid-March 2011.

From the above, it is determined that the number of small-scale aquaculture farmers, raised

as a project objective, increased to about 9,000 from the 2,000 before project planning, and thus more than twice the target number of farmers are conducting aquaculture in the target provinces. In addition, in relation to the overall goal, as it has been confirmed that during the Project the amount of aquaculture production in the target provinces increased by 1.65 times, the manifestation of the plan's effects can be seen and therefore the effectiveness and impact is considered high.

### 3.3 Efficiency (Rating: ③)

#### 3.3.1 Inputs

The input plan and actual performance of this Project are as follows.

Inputs	Plan	Actual Performance (as of the end)
(1) Experts	Chief advisor / extension administration, farming technology improvement and dissemination, rural development / operational coordination Parent fish cultivation / seed production, participatory planning, bait development, shared pond management, gender mainstreaming, fish distribution, facility design, bidding assistance / supervision of works other	Japanese experts 11 For 11 fields, a total of 164.9MM  Third Country Expert 8 , total 10.3MM (Indonesia, Vietnam, India, Nepal)
(2) Trainees received	Training in third countries or Japan, 2-3 trainees each year.	Trainees in Japan 7
(3) Third-Country Training Programs		Third Country Trainees 77 (Host countries: Philippines, Vietnam, Thailand, Indonesia, Singapore)
(4) Equipment	Vehicles, various farming equipment etc.	Equipment provision 27 million yen Facility improvement 20 million yen
Total project cost	Total 550 million yen	Total 513 million yen
Recipient government's input amount	In terms of local cost, since the principle amount was a counterpart provision and isolating only the budget for this Project is difficult, the budget has not been established.	For the reason on the left, the amount of input from the Cambodia side has not been added.

#### 3.3.1.1 Elements of Inputs

Inputs on the Japan side including items such as the dispatch of experts, training in Japan, third country training, provision of equipment, were conducted largely as planned. The period of dispatch for Japanese experts, their expertise and leadership abilities were evaluated

highly on the Cambodian side, and the equipment (ex. fish hatcheries for seed farmers) provided is still being utilized at the time of ex-post evaluation.

Third Country Training and dispatch of third Country Experts have been conducted in this Project. In regards to this, concerned parties acknowledged that they were very helpful and effective since Cambodian counterparts could learn slightly more advanced technology (attainable technology) from the countries with similar environments with Cambodia (fish species, etc.). In particular, Third Country Training Programs in Singapore and Indonesia were appreciated with trainees because it was possible to learn all technologies in a straightforward manner.

On the Cambodia side, a counterpart was established for project activity promotion and cases of long-term training or absence due to transfers were kept to a minimum and there were no disruptions to project activity.

#### 3.3.1.2 Project Cost

Project cost was within the 93% of the initial budget.

#### 3.3.1.3 Period of Cooperation

Project period was as planned (100% consistent with planned period).

From the above, in relation to project cost/period, the efficiency of this Project is high.

### **3.4 Sustainability (Rating: ③)**

#### 3.4.1 Related Policy towards the Project

The latest development plan is the National Strategic Development Plan (2009-2013). As with the previous development plan it sets "agricultural development" as a priority area, aiming at poverty reduction and food security for the local population, it seeks to promote the management, conservation and development of effective and sustainable marine resources. In particular, it has been mentioned that in aquaculture development, since aquaculture farms play an important role in the preservation of marine resources, the provision of seeds and technical support is required.

Developed with the assistance of the EU, the "Strategic Planning Framework for Fisheries: 2010-2019" strove for numerical targets in aquaculture production volume from 40,000 tons in 2008 (reference value) to 10.2 million tons in 2015 and 18.5 million tons in 2019, increased numbers of cultivated aquaculture farmers (2008: 44,000 -> 2015: 65,000 -> 2018: 85,000) and increased seed production (2008: 37 million -> 2015: 150 million -> 2018 : 250 million). In addition, with respect to community shared ponds, using the reference value of 2009 (235 locations) numeric goals were set of 1,200 locations by 2019. In this context numerical targets

for production from rice paddy fisheries were set from 110,000 tons in 2008 (reference value) to 225,000 tons in 2015, then up to 50 million tons 2019. Furthermore, a master plan which sets a more concrete framework (five-year plan: August 2013 to July 2018) is currently under development with support from the EU and it is expected to continue support of aquaculture farmers in the future, therefore it is determined that the sustainability of policies and institutions is high.

On the other hand, in hearings with seed producing farmers, the need to provide regulation on imports of seed from Vietnam etc. was requested by network officials in each province. The survey data of 2007 indicates that 18% of seeds in circulation in Cambodia were of domestic production, 26% were natural fry and the remaining 55% were dependent on imports from Vietnam, etc. For this reason, the Cambodian government is attempting to increase domestic seed production and is seeking to reduce the volume of imports but in response to the recent spread of aquaculture technology in Cambodia, seeds produced in Vietnam that are cheaper than those domestically produced have begun to circulate in rural areas. Sometimes the quality of some of these seedlings is low and voices of concern have been heard from seed producing and aquaculture extension workers from provincial FiA. However, one factor of imported seeds' distribution is the fact that domestic seed production cannot always ensure adequate amounts corresponding to the demands of the season. Therefore, in order to expand future small-scale aquaculture techniques, it is important to tackle quality control and management of seasonal seed production (including imported seeds) for seeds distributed within the country.

#### 3.4.2 Institutional and Operational Aspects of the Implementing Agency

During the period of this Project, as part of the flow of administrative reform, the provincial fisheries offices was transferred from provincial governments to the FiA in order to form a uniform chain of command. As a result, central and local diffusion efforts have been integrated and the mobility required to expand in line with the basic policy of the FiA has been increased. This system was being maintained at the time of ex-post evaluation and training and so on of small aquaculture farmers and support for seed producing farmers in the target four provinces was being carried out by the FiA staff. At the same time Japanese experts of Phase 2 have recognized that smooth communication between central and provincial staff has contributed to select<sup>6</sup> the most appropriate seed farmers from the target

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<sup>6</sup> Selection of seed farmers: According to the FiA, in current farmer selection, tests are conducted after giving consideration to (1) the Environment (natural conditions, social conditions, and land ownership), (2) the economy (not the most wealthy but also not the most poor), (3) experience, (experience conveying aquaculture technology and maintaining harmonious relationships with neighboring farmers etc.), and (4) interest (interest in involving their wife in farming). In these tests, as observed successful husband and wife farmer candidates were those who are genuinely interested in aquaculture and begin aquaculture

areas.

Further, in this Project, the support and involvement of government officials was minimized and the main component established was the technique of technology transfer among farmers and this approach was a major factor contributing to the success of achieving the project objective. Specifically, three stages of technology transfer from (1) Japanese experts to government extension workers (provincial Departments of Fisheries) (2) from government extension workers to seed producing farmers and (3) from seed producing farmers to small scale farmers is being pushed forward with the recipient establishing extension methods each time and, at the time of project completion, stages (2) and (3) were being continued. In particular,(3) technology transfer from seed producing farmers to small scale farmers was continuing and expanding ex-post evaluation and, even though three years has elapsed since project completion, it has been confirmed that through this method of extension, the receiving of aquaculture technology is still expanding throughout the regions of the four target provinces.

One factor that seed producing farmers focus on in the training of small-scale farmers is establishing that there are clear economic incentives (revenue increases) and as seed producing farmers see small-scale farmers as important customers, they have become an active driving force in activities promoting seed purchase.

In addition, the Implementing agency of this Project, the Ministry of Agriculture, Forestry and Fisheries, Fisheries Administration (FiA), with not only support from Japan, but also from the EU, Netherlands, Spain, etc., is endeavoring to reinforce matters at the policy level.

From the above, the systems of the Implementing agency and the sustainability of the terminal extension system is judged to be high.

### 3.4.3 Technical Aspects of the Implementing Agency

At the time of terminal evaluation, through the implementation of this Project, the counterpart's technical capabilities and extension capacity were improved, seed producers were nurtured through their guidance, and farmer to farmer technology transfer occurred through the sales of cultivated seeds. The step-by-step technology transfer strategy of this Project proceeded as planned and the number of recipients of technology increased dramatically at each stage. Further, by using the technology that had already been accumulated to its utmost capacity, technology suitability was high and was evaluated to be a factor in technology transfer and development.

At the end of the Project, technology transfer among farmers was being continued. In this

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through their own power without any support, selection is carried out after a final (4) interest check has been confirmed.

context, the regional appropriateness of technology introduced has been raised. First, it may be mentioned that for seedling production technology, with a focus on fish species that are popular in Cambodia, advantage was taken of the technology of pioneering farmers who were already engaged in seed production in the target areas prior to project implementation, and so they were not entirely new technologies. Also, in regards to small-scale aquaculture technology, the fertilization technique of using grain residue or livestock manure from farmers was used as a basis, therefore the use of plankton that does not rely on feeding and fish that feed on plant matter etc. was intended and low input technology that does not burden small scale farmers was introduced. Though this was during implementation of the Project, it was a factor that increased the trainee retention rate after one year (90%). In addition, in the target areas there is a custom of digging one's own reservoir pond in the garden for domestic water in order to cope with water shortages in the dry season. Therefore there is the possibility for most farmers to use this existing reservoir pond to start aquaculture which is also becoming a factor in promoting and expanding aquaculture in the target areas.

From the above it can be suggested that the technology transfer of this Project is progressing smoothly and the possibility of aquaculture technology spreading in the target areas is high. In addition, in response to the success of this Project, the FiA is showing clear policies directed at expanding the spread of small-scale aquaculture through the development of seed producing farmers in other provinces and regions, and donors including Japan and NGOs are actively supporting this. Due to this, the sustainability of the technical aspects of the Project are considered high.

#### 3.4.4 Financial Aspects of the Implementing Agency

The Project aims to establish a seed producing farmers' network and promote the spread of aquaculture through a farmer to farmer extension system. Therefore, it has been assumed that at the terminal evaluation, if a self-reliant network can be established, continuance and maintenance of the small-scale aquaculture activities of the Project that do not require large scale use of the FiA budget can be spread throughout the target area. As a consequence, the network is functioning, even at the time of ex-post evaluation, the number of small-scale aquaculture farmers is increasing.

However, since only seed farmers were trained in the Project due to it not being feasible to supply seeds to all of the target provinces, the training of seed producing farmers by the FiA will be required further in the future. After a review of the annual budget of the FiA regarding small-scale farming (national) in the ex-post evaluation, in 2012 it was about USD 26,250 (105,000,000 Riel). Even though there is a support policy for aquaculture promotion, it cannot be said that there is sufficient financial resources to systematically increase the number of seed producing farmers in the target provinces in future, thus the cooperation of

donors is indispensable.

On the other hand, for credit businesses run through the networks, there was a concern from seed producing farmers seeking to expand business at the point of terminal evaluation. After a review of the current situation in the study, differences in the financial resources possessed by each provincial network were discovered. For example, while the Prey Veng network does not currently have adequate financial resources to run a credit network, since leaders of the Takeo province network have large financial resources and strong practical abilities a credit business is beginning to function. For this reason, support to boost the functions of the networks such as refresh trainings for accountants and leaders is also important.

From the above, the present Project's institutional policy as well as counterpart system, technology, and financial situation are without impediment and therefore the sustainability of outputs realized by this Project is high.

## **4. Conclusion, Lessons Learned and Recommendations**

### **4.1 Conclusion**

This Project was planned when the Cambodian government was working for aquaculture promotion that would contribute to nutritional improvement and poverty reduction for rural residents. The four Southern provinces of the project target are located distant from major freshwater fisheries such as the Tonle Sap and the Mekong River. Also, in these rural areas, freshwater fisheries have not been common practice among small-scale farmers. Given these circumstances, the Project, which aimed at extending aquaculture and increasing freshwater-cultured fish production, is considered to have been consistent with policy objectives of the Cambodian government and development needs of the country.

While the number of small-scale aquaculture farmers remained 2,000 prior to the project implementation, it has achieved 9,000, more than doubling of the project objective targeted 4,400. In addition, in relation to the overall goal, as it has been confirmed that during the Project the amount of aquaculture production in the target provinces increased by 1.65 times, the manifestation of the plan's effects can be seen and therefore the effectiveness and impact is considered high.

In terms of the cost and period, the Project has been implemented as planned, and therefore, the efficiency is evaluated to be high.

The sustainability of the Project is considered to be high as the existing system and policies in the country are supportive. The ongoing national development policies emphasize the aquaculture development shall play a crucial role to improve management, preservation and development of marine resources. Also, the target areas are suitable in extending aquaculture,

given its natural environment, a food culture, the localities and a lifestyle of people. In fact, seed-producing farmers, trained by extension officers, have been transferring their technologies to small-scale farmers through sales of their seeds. This step-by-step technical transfer among farmers has been retained after the project completion, and therefore, the sustainability of the Project is considered to be high in terms of technical feasibility. As for financial sustainability, the ex-post evaluation study has observed seed-producing farmers have continued their activities, using their network. Thus, aquaculture has gained a solid ground for its technological extension, which allows FiA to manage at lower cost. Given these circumstances, the sustainability of the Project is considered to be high.

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

## **4.2 Recommendations**

### **4.2.1 Recommendations to the Implementing Agency**

Due to the spread of aquaculture technology in rural areas, inexpensive import seed from countries like Vietnam has begun to circulate into rural areas. However government extension workers and seed producers have raised the issue that often the quality of these imported seeds is poor and they have a low survival rate. The fact that the techniques established in this project are not only low-input aquaculture technologies that use rice paddies and reservoir ponds, but that they also reduce as much as possible the risk of lost fish (an important food staple) in the growth phase, is an important factor in helping to expand the spread of this technology. For this reason, quality control of imported seed is important. In addition, it is important for the FiA to start assistance initiatives for areas such as quality control and seasonal management to be able to ensure that production activities can be carried out for domestic seed of a fixed quality at times when farmers need.

### **4.2.2 Recommendations to JICA**

Similar projects utilizing the success factors of this project expanded to other provinces in Phase 2 and there are also others being carried out in Africa. From the results of these activities in other countries and other regions, deeper verification of the success factors of this project will be useful.

## **4.3 Lessons Learned**

A success factor of this project mentioned was that it established simple, low-input aquaculture technology that was highly suitable for the natural environment, food culture, locality, and lifestyles of the target areas.

In particular, the following items were pointed out.

[Effective use of local resources and high development needs]

- The demand for freshwater fish is large, with high needs for both home consumption and sales, and a market for sales already exists.
- The government recognized freshwater fish as an important source of protein and had been promoting a strong policy of inland water culture.
- The use of already existing reservoir ponds and rice paddies for aquaculture ponds and taking full advantage of regional resources, such as rice bran, for feed.

[Introduction of technology that enables dissemination among farmers]

- Seedling production technology with a low degree of difficulty has been adopted but, for hatching and breeding, uniform technological strength is required and so an ongoing sales and purchase relationship between the aquaculture farmers and seed producers was established.
- It was low-input and simple aquaculture technology that could be carried out by farmers also engaged in rice cultivation.

[Extension development left to the structure making of market expansion]

- On the recognition that widespread adoption through the government alone would be difficult, a project design where, after a certain amount of support was granted from the government, regional extension would be left to the expansion of the market was implemented.
- Seed producing farmers transfer technology to other farmers having the clear economic benefit incentive of "seeds sales revenue."
- By training a large number of farmers, the opportunities for farmers to start their own businesses increased and these many successful experiences contributed to the building of an aquaculture market in the region.

From the above, in order for the Project to be acceptable to the target area, at the planning stage of the Project, sufficient study of the mechanism of extension development with consideration given to the confirmation of government policies and measures, assessment of the needs of residents, use of local resources, the setting of the technical level to be introduced, and the expansion of the market is essential. The present Project's approach of maximizing the utilization of local resources combined with incentives for the manufacturing and economic activities of local residents and the approach of expanding and ripening the existing market in the target area is not just relevant to the aquaculture field but can also be considered lessons for other community development projects.