ANNEX 4

(Final Report)

Evaluation of extension officer

August 18, 2014

Evaluation for Extension Capacity of Local Extension Officers in Three Target Provinces

1. Purpose and Method

The Project Design Matrix (PDM) indicates “Strengthening the capacity of local administration on aquaculture extension” as an expected output of the project. As an indicator for evaluating the achievement of the output, the PDM also indicates “Improvement of extension capacity of local extension officers for fish culture and seed production”. In October and November 2011, the first year of the project, we conducted a questionnaire survey to measure the extension capacity of local extension officers. This time, we also asked local extension officers, who are engage in the project as counterparts, to answer the same questionnaire for self-evaluation of their extension capacities. The questionnaire sheet for the survey is attached as Annex.

2. Evaluation Method

In order to verify the proper levels of technical extension of local extension officers, 13 technical items for self-evaluation were prepared as follows. For respective technical items, extension officers answered their achievement by the following competency levels of extension capacity.

Extension Technical Items (13 items)

Seed production for respective target fish species (Silver Barb, Common Carp, Silver Carp, Murgal, and Tilapia), Broodstock culture, Nursery of fish seeds, Home-made feed making, Feeding management, Pond construction and preparation, Fertilization of fish ponds, Fish disease treatment, Record taking for fish culture.

Level of Competence (5 levels)

Level	Achievement of Extension Capacity	Technical Score
A	Enough technical skills and a lot of experiences of technical advice to farmers	5
B	Enough technical skills, but a little experiences of technical advice to farmers.	4
C	Enough technical skills, but no experiences of technical advice to	3

	farmers.	
D	A little technical skills	2
E	No technical Skills	1

According to the competency level, technical scores are determined between 1 and 5. If the technical level is more than Level B (technical score is more than 4), it could be considered that field officers have sufficient extension skills for fish seed production and pond culture.

3. Result of the Evaluation

Table 1 and Figure 1 shows the average technical scores of all extension officers. The average technical score of counterpart's extension officers in 2014 attains 4.05. It is higher than the Level B (technical score: 4) which is a sufficient level for extension activities. Because the average technical score in 2011 was 3.26, it means that extension officers gradually raise technical level in the project period.

Table 1: Achievement of Extension Technical Level of Local Extension Officers

Year	Average Technical Score		Distribution of Technical Scores			
			1.0 - 1.9	2.0 - 2.9	3.0 - 3.9	4.0 - 4.9
2014 (End-line)	4.05	No. of persons	0	1	4	12
		Share	0%	6%	25%	86%
2011 (Base-line)	3.27	No. of persons	2	4	4	6
		Share	13%	25%	25%	3 %

Note: To compare with the figure of Year 2014 properly, the baseline score of Year 2011 is added with the technical scores of Year 2011 of two extension officers (Mr. San Mardy and Mr. Srey Keovsopheak), who became project counterparts in 2012 to 2013. Therefore, the average technical score of Year 2011 is a little smaller than the figure (3.55) reported on the annual project report of Year 2011.

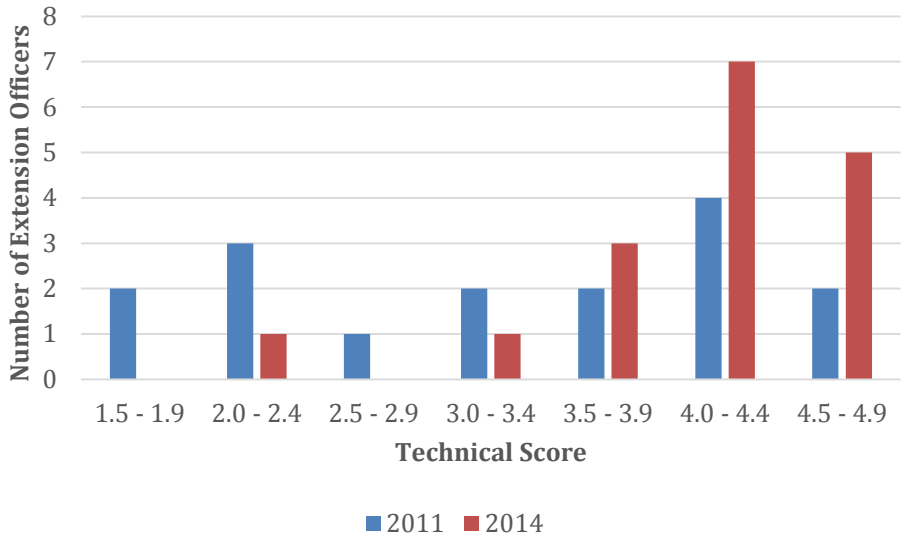


Figure 1: Distribution of Extension Technical Scores in 2011 and 2014

Table 2 and Figure 2 shows the average technical scores of respective extension technical items. The technical items, which have not attained the target score 4.0, are seed production of Silver Carp and Murgal, Home-made fish feed making, and Fish diseases treatment. The project should cover up these four technical items in follow-up programs to enhance the effect of technical improvement. In other technical items, the technical scores have attained more than 4.0 on the average. It means that extension officers have mastered these technical items for extension activities.

Table 2: Average Technical Score in Respective Extension Technical Items

Extension Technical Item	Average Technical Score	
	2014 (End-line)	2011 (Base-line)
Seed Production: Silver Barb	4.17	3.56
Seed Production: Common Carp	4.11	3.38
Seed Production: Silver Carp	3.28	2.69
Seed Production: Murgal	3.89	2.81
Seed Production: Tilapia	4.56	3.38
Broodstock Culture	4.22	3.31
Nursery of Fish Seeds	4.00	3.25
Home-made Fish Feed Making	3.67	2.56
Fish Feeding Management	4.11	3.63
Pond Construction and Preparation	4.83	4.25
Fertilization of Fish Pond	4.83	4.25

Fish Disease Treatment	2.67	1.94
Record Taking of Fish Culture	4.33	3.56
Total items	4.05	3.27

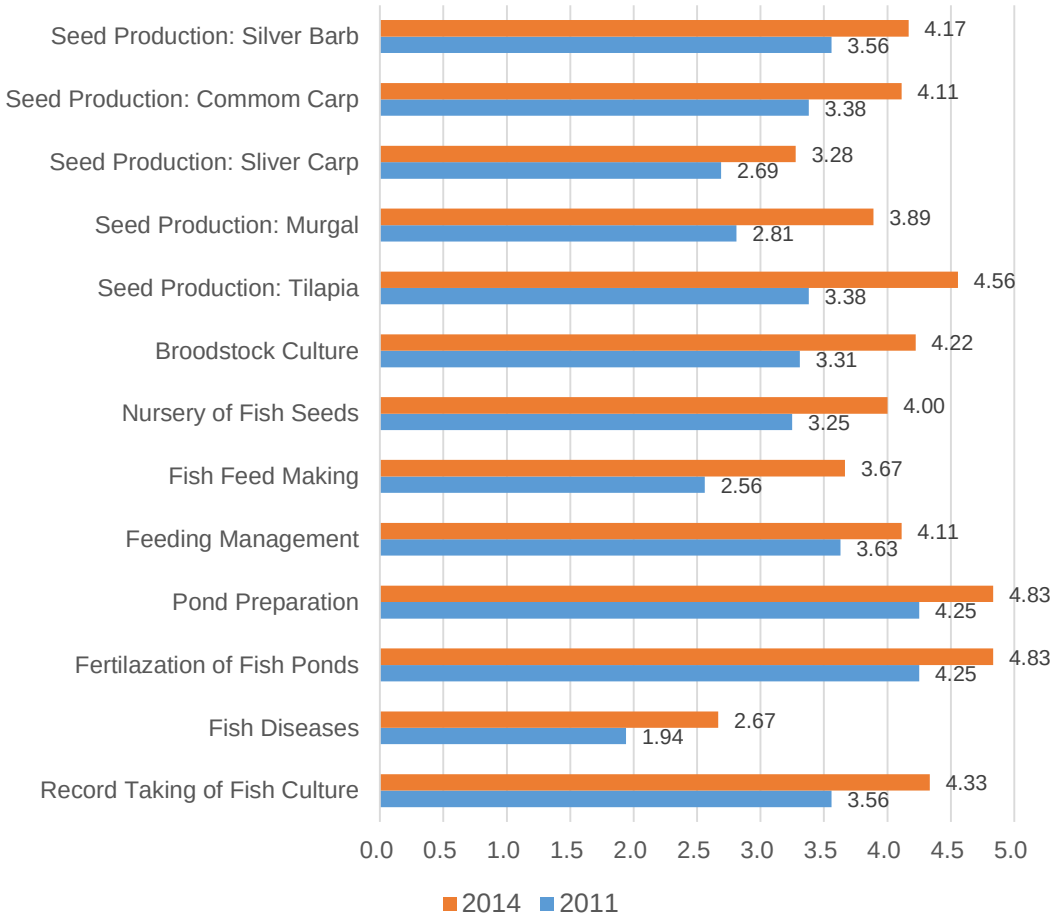


Figure 2: Average Technical Scores of Respective Technical Items in 2011 and 2014

4. Technical Issues

According to the result of self-evaluation by extension officers, the weakness of extension technical items are seed production (especially, Silver Carp), home-made feed making, and fish disease treatment. In terms of those weak items, we confirmed the detail causes and problems by the individual interviews with extension officers. The interview results of weak technical items are summarized below.

1) Seed Production

In terms of Silver Carp, many extension officers indicated the difficulty of stable seed production. Especially, most difficult technical points for extension activities are 1) selection and culture of high quality broodstock, 2) inducement for spawning by hormone injection, and

3) nursery of fish seeds in ponds. In terms of seed production techniques of other fish species (Silver Barb, Common Carp, Murgal, and Tilapia), most extension officers have attained the sufficient level of technical advice to local farmers.

Moreover, according to their practices of seed production, they could not stop a decrease of fish seeds in ponds at the nursery stage. Many of them pointed out a sudden change of water condition in nursery ponds as main reasons for low survival rate at nursery stage.

2) Home-made Feed Making

According to the interview with extension officers, there are not any difficulties in their understanding and advice on home-made fish feed making. Actually, they advised the techniques, how to cook local materials for feeding fish, to local farmers. Recently, commercial compounded feeds expand gradually for fish culture. Therefore, the request of fish farmers for home-made pellet production by locally available materials, such as rice bran, fish meal, aquatic weed, etc., is increasing.

3) Fish Disease Treatment

Serious fish diseases rarely happen on small-scale freshwater aquaculture. However, some extension officers intend to learn a practical diagnose and treatment for fish diseases for future extension activities.

Besides the issues above-mentioned, some extension officers request to learn the techniques of seed production of Catfish and Pangasius. Based on these technical issues, the project should make some follow-up activities in the technical aspect during the remained implementation period.

Annex: Questionnaire of Extension Technical Levels for Counterpart Extension Officers

Questionnaire of Aquaculture Extension Activities

បញ្ជីសំណួរ សកម្មភាពផ្សព្វផ្សាយវារីវប្បកម្ម

For Extension Officers

សម្រាប់មន្ត្រីផ្សព្វផ្សាយ

Freshwater Aquaculture Improvement and Extension Project Phase 2 (FAIEX 2)

គម្រោងបង្កើនផលិតភាព និងផ្សព្វផ្សាយវារីវប្បកម្មទឹកសាប ដំណាក់កាលទី ២

I. Basic Profile of Extension Officer

គោលសំខាន់ៗរបស់មន្ត្រីផ្សព្វផ្សាយ

Name ឈ្មោះ	
Age អាយុ	_____ years old ឆ្នាំ
Education Background ការសិក្សាពីមុន	☐ Primary school បឋមសិក្សា, ☐ Secondary school អនុវិទ្យាល័យ, ☐ High school វិទ្យាល័យ, ☐ Collage មធ្យមបច្ចេកទេស, ☐ University មហាវិទ្យាល័យ, ☐ Other ផ្សេងៗ (_____)
Experience of aquaculture extension បទពិសោធន៍ការផ្សព្វផ្សាយវារីវប្បកម្ម	_____ Years ឆ្នាំ

II. Technical Knowledge in Aquaculture

ចំណេះដឹងលើបច្ចេកទេសវារីវប្បកម្ម

How are your technical skills for extension activities in each subject?

តើបទពិសោធន៍បច្ចេកទេសរបស់អ្នក សម្រាប់សកម្មភាពផ្សព្វផ្សាយក្នុងគ្រប់ប្រធានបទយ៉ាងដូចម្តេច?

Level កំរិត	Evaluation Standard គំនូរាយតម្លៃ
A	Enough technical skills and a lot of experiences of technical advice to farmers. ជំនាញបច្ចេកទេសគ្រប់គ្រាន់ និងបទពិសោធន៍បច្ចេកទេសច្រើន សម្រាប់ផ្តល់ដល់កសិករ
B	Enough technical skills, but a little experiences of technical advice to farmers. ជំនាញបច្ចេកទេសគ្រប់គ្រាន់ ប៉ុន្តែបទពិសោធន៍បច្ចេកទេសតិចតួច សម្រាប់ផ្តល់ដល់កសិករ
C	Enough technical skills, but no experiences of technical advice to farmers. ជំនាញបច្ចេកទេសគ្រប់គ្រាន់ ប៉ុន្តែមិនមានបទពិសោធន៍បច្ចេកទេសសម្រាប់ផ្តល់ដល់កសិករ
D	A little technical skills មានជំនាញបច្ចេកទេសតិចតួច
E	No technical skill មិនមានជំនាញបច្ចេកទេស

Technical subjects ប្រធានបទបច្ចេកទេស	Technical Achievement Level កំរិតស្នាដៃបច្ចេកទេស				
	A	B	C	D	E
Seed production: Silver Barb ការផលិតពូជត្រីគ្តិន	☐	☐	☐	☐	☐
Seed production: Common carp ការផលិតពូជត្រីកាបសាមញ្ញ	☐	☐	☐	☐	☐
Seed production: Silver carp ការផលិតពូជត្រីកាបស	☐	☐	☐	☐	☐
Seed production: Mrigal ការផលិតពូជត្រីម្រីហ្គាល់	☐	☐	☐	☐	☐
Seed production: Tilapia ការផលិតពូជត្រីទីឡាព្យា	☐	☐	☐	☐	☐
Broodstock culture ការចិញ្ចឹមបំប៉នមេពូជ	☐	☐	☐	☐	☐
Nursering of fish fries ការថែរក្សាកូនពូជ	☐	☐	☐	☐	☐
Fish feed making ការផលិតចំណី	☐	☐	☐	☐	☐
Feeding management ការគ្រប់គ្រងចំណី	☐	☐	☐	☐	☐
Pond preparation ការរៀបចំស្រះ	☐	☐	☐	☐	☐
Fertilization of fish pond ការដាក់ជីរុស្រះត្រី	☐	☐	☐	☐	☐
Fish disease ជម្ងឺត្រី	☐	☐	☐	☐	☐
Record taking of fish culture កត់ត្រាការចិញ្ចឹមត្រី	☐	☐	☐	☐	☐

August, 2014

Verification Survey for Core Farmers on Condition of Seed Production and Satisfaction of Extension Services

I. Contents of the Survey

1. Purpose and Method of the Survey

The Project Design Matrix (PDM) indicates “Strengthening the capacity of local administration on aquaculture extension” as an expected output of the project. As an indicator for evaluating the output, the PDM also indicates “Level of satisfaction of core farmers to aquaculture extension service”. To verify the achievement of the indicator, the survey team, comprising a Japanese expert in charge of aquaculture extension and a project counterpart of Department of Aquaculture Development in Fisheries Administration (FiA), visited the core farmers (fish seed producers) of three target provinces, and interviewed with them in their satisfaction of aquaculture extension service. In addition, the survey team confirmed the present condition of their fish seed production.

The questionnaire sheet for interview with core farmers is attached as Annex 1. However, local farmers hardly read and answer the questionnaire by themselves. Therefore, a Japanese expert and a FiA’s counterpart explained the questions to them and heard their answers in interview style. Beside the contents of the questionnaires, the survey team flexibly added some relevant questions in accordance with farmer’s answers and fish farm’s condition. It helps to understand the actual condition of core famers in detail.

2. Survey Period

The survey team visited three target provinces on the following schedule. At the same time, the team conducted the confirmation survey on the capacity of local extension officers.

Survey Period	Target Province	Survey Team
August 5 (Tue) to 8 (Fri)	Battambang (Aug. 5 – 7) Pursat (Aug 7 – 8)	Mr. Chhor Bunly Mr. Mitsuo Iinuma
August 13 (Wed) to 15 (Fri)	Siem Reap	Mr. Ouch Lang Mr. Mitsuo Iinuma
August 21 (Thu) to 22 (Fri)	Pursat	Mr. Chhor Bunly Mr. Mitsuo Iinuma Mr. Yasuyuki Niwa

3. Target Farmers for the Survey

The project trained and raised total 44 core famers (fish seed producers). However, 5 core farmers (1 in Siem Reap, 2 in Battambang, and 2 in Pursat) already suspended to produce fish seeds due to various

personal reasons. Therefore, the inactive farmers were excluded as targets for the survey. Finally, 39 core famers were selected as target farmers for the survey.

However, the survey team could not contact to some farmers by phone, or hardly reached to their places on bad road condition, caused by heavy rain in the survey period. In those cases, the team gave up visiting them. Finally, the survey team could visit 32 active core farmers in all target provinces. It accounts for about 80 % of target core farmers.

Table 1: Target Core Farmers and Coverage of the Survey

Province	Core Farmers Visited by the Survey Team	Active Core Farmers	Coverage by the Survey
Siem Reap	9 farmers	10 farmers	90.0 %
Battambang	11 famers	14 farmers	78.6 %
Pursat	12 farmers	15 farmers	80.0 %
Total Target Provinces	32 farmers	39 farmers	82.1 %

II. Results of the Survey

1. Seed Production Condition

The survey team confirmed the technical capacities of fish seed production and problems and difficulties with core farmers. Table 2 and 3 indicate the current condition on fish seed production of core farmers in respective fish species. Among the project target species, Silver Barb and Tilapia are most popular for fish seed production. About 90 % of core farmers produce Silver Barb and Tilapia. Common Carp is the second popular fish for seed production. About 70 % of core farmers engage in seed production of Common Carp.

In case of Murgal and Silver carp, the ratio of operation of seed production is very low. It accounts for only 30 % in Murgal and less than 10 % in Silver Carp. In Murgal, because its local demand for sale and consumption is smaller, there are not many request for seed supply from local farmers. Therefore, many core famers stop to produce Murgal seeds. In Silver Carp, many famers cannot produce fish seeds stably due to technical difficulties; mainly, brood fish do not spawn eggs after hormone injection. In addition to low survival rate of fish seeds, local demand of Silver Carp is also small. For these reasons, many core farmers suspend seed production in Silver Carp.

In case of Silver Barb and Tilapia, because the technique of seed production is simple and easy, local famers can produce a large number of fish seeds stably. Additionally, these both species have high demand at local market. Therefore, most famers prefer to produce Silver Barb and Tilapia seeds.

Table 2: Seed Production Condition of Core Farmers in Target Fish Species of the Project (August 2014)

Species	Silver Barb			Common Carp			Silver Carp			Murgal			Tilapia		
Level of Production	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Siem Reap	67%	11%	22%	67%	11%	22%	11%	22%	67%	33%	11%	56%	89%	0%	11%
Battambang	91%	9%	0%	73%	9%	18%	0%	45%	55%	27%	64%	9%	82%	18%	0%
Pursat	100%	0%	0%	67%	33%	0%	8%	50%	42%	33%	33%	33%	92%	8%	0%
Total	88%	6%	6%	69%	19%	13%	6%	41%	53%	31%	38%	31%	88%	9%	3%

Note: The marks of “Level of Production” show the following condition of seed production activities.

A: Produce fish seeds, B: Not produce fish seeds; but keep broodstock

C: Not produce fish seeds, and not keep broodstock

The most serious issue of seed production activities is low survival rate of fish seeds in nursery ponds. According to the answers of core farmers, the possible causes of low survival rate might be the quality of fish eggs spawned by low quality brood fish and a sudden change of water condition at nursery ponds (sudden change of water temperature, worsening of turbidity of pond water, etc.). Therefore, many core famers consider to raising high quality brood fish and securing underground water by digging deep wells as necessary measures for increase the survival rate of fish seeds.

Some core farmers also engage in seed production of other fish species, Catfish, Pangasius, and Walking Perch. Especially, in case of Catfish, about a half of core farmers engage in Catfish seed production by themselves. About 20 % of them have already produced and sold Catfish seeds. In fact, it is easy to catch and collect wide Catfish for broodstock at natural water areas like rivers and ponds. In addition, the basic technique of Catfish seed production was already established. Local market demand of Catfish is also quite high. Therefore, most core farmers expect future technical assistance of Catfish seed production as new potential fish species.

Table 3: Seed Production Condition of Core Farmers in Other Fish Species (August 2014)

Fish Species	Catfish			Pangasius			Walking Perch		
Level of Production	A	B	C	A	B	C	A	B	C
Siem Reap	44%	0%	56%	0%	0%	100%	22%	0%	78%
Battambang	18%	27%	55%	0%	9%	91%	0%	0%	100%
Pursat	8%	42%	50%	0%	0%	100%	0%	0%	100%
Total	22%	25%	53%	0%	3%	94%	6%	0%	94%

Note: The marks of “Level of Production” show the following condition of seed production activities.

A: Produce fish seeds, B: Not produce fish seeds; but keep broodstock

C: Not produce fish seeds, and not keep broodstock

2. Satisfaction Level of Extension Services

In this survey, core farmers answered the satisfaction level of whole extension services, provided by extension officers, on three important subjects, Technical Advices, Communication, and Networking Facilitation. As indicated at Table 4, all core farmers answered “Very good” or “Good” on all subjects. It means that all core farmers are satisfied of the extension services in the project.

Table 4: Evaluation of Whole Extension Service by Core Farmers (August 2014)

Extension Subject	Technical Advice			Communication			Networking Facilitation		
Level of Evaluation	Very Good	Good	Need Effort	Very Good	Good	Need Effort	Very Good	Good	Need Effort
Siem Reap	100%	0%	0%	78%	22%	0%	100%	0%	0%
Battambang	100%	0%	0%	100%	0%	0%	100%	0%	0%
Pursat	100%	0%	0%	100%	0%	0%	100%	0%	0%
Total	100%	0%	0%	94%	6%	0%	100%	0%	0%

Note: The questionnaire requests an answer by four levels (Very Good, Good, Common, Bad). Actually, we have the answers of only two levels, Very Good or Good. To simplify the results, other two levels (Common and Bad) are summarized into “Need Effort” on the Table.

In terms of Technical Advices, core farmers also answered their satisfaction levels on six important technical subjects, seed production, pond preparation, home-made feed making, feeding management, water quality control, and fish disease treatment, respectively. In all subjects, except fish disease treatment, all core farmers answered only “Very Satisfied” or “Satisfied”. It means that all core farmers are satisfied of technical advices provided by extension officers in these five technical subjects. In home-made feed making and water quality control, about 10 % of core farmers answered “Satisfied”, not “Very Satisfied”. In both subjects, basically, they are satisfied of technical advices of extension officers. However, in terms of home-made feed making, some core farmers expect that the project might provide pelleting machines. In terms of water quality control, they expect to use water quality devices like pH meter (acid level) and DO (dissolved oxygen) meter. These expectations might reflect their answers.

In terms of fish disease treatment, because all core farmers did not faced any serious fish diseases, they have not need particular technical advices for fish disease treatment. Therefore, many farmers held their answers about fish disease treatment in abeyance, because they hardly decided it properly. However, nobody answered “Not Satisfied”. Moreover, the interview with core farmers confirmed that extension officers gave advices on fish disease treatment, according to their inquiries. Consequently, their satisfaction on fish disease treatment is also highly achieved.

Table 5: Satisfaction Level of Technical Advices by Core Farmers in Technical Subjects (August 2014)

Technical Subject	Seed Production			Pond Preparation			Home-made Feed Making		
Level of Evaluation	Very Satisfied	Satisfied	Need Effort	Very Satisfied	Satisfied	Need Effort	Very Satisfied	Satisfied	Need Effort
Siem Reap	89%	11%	0%	100%	0%	0%	56%	44%	0%
Battambang	100%	0%	0%	100%	0%	0%	100%	0%	0%
Pursat	100%	0%	0%	100%	0%	0%	100%	0%	0%
Total	97%	3%	0%	100%	0%	0%	88%	13%	0%

Technical Subject	Feeding Management			Water Quality Control			Fish Disease Treatment			
Level of Evaluation	Very Satisfied	Satisfied	Need Effort	Very Satisfied	Satisfied	Need Effort	Very Satisfied	Satisfied	Need Effort	Abeyance
Siem Reap	89%	11%	0%	78%	22%	0%	0%	11%	0%	89%
Battambang	100%	0%	0%	82%	18%	0%	27%	0%	0%	73%
Pursat	100%	0%	0%	100%	0%	0%	75%	0%	0%	25%
Total	97%	3%	0%	88%	13%	0%	38%	3%	0%	59%

III. Conclusion

In spite of a limitation of survey period, the survey team could visit more than 80 % of active core farmers, and interview with them to confirm their seed production activities. In fact, all core farmers, whom the team could visit, answered their high satisfaction on extension services provided by extension officers. It indicates the achievement of the indicator of the project output, “More than 80 % of core farmers are satisfied of extension services”.

Moreover, the survey reveals that most core farmers give a priority to Silver Barb, Tiliapia, and Common Carp for seed production and supply, because the techniques of their seed production are simple and stable, and the local demands of their sale and consumption are also high. In addition, the survey also shows that about a half of core famers engage in Catfish seed production, including the farmers who raise brood fish for future production. The technical advice of Catfish seed production is one of important issues on extension activities in the future.

Annex 1: Questionnaire Sheet for Interview with Core Farmers

Questionnaire of Aquaculture Extension Activities

បញ្ជីសំណួរ សកម្មភាពផ្សព្វផ្សាយវារីវប្បកម្ម

For Fish Farmers

សម្រាប់កសិករចិញ្ចឹមត្រី

Freshwater Aquaculture Improvement and Extension Project Phase 2 (FAIEX 2)

គម្រោងបង្កើនផលិតភាព និងផ្សព្វផ្សាយវារីវប្បកម្មទឹកសាប ដំណាក់កាលទី ២

I. Basic Profile of Farmers មូលដ្ឋានគ្រឹះរបស់កសិករ

Name ឈ្មោះ			
Age អាយុ	_____ years old ឆ្នាំ	Sex ភេទ	☐ Maleប្រុស, ☒ Female
Village		Commune	

II. Seed Production

Cultured fish species ប្រភេទដាក់ចិញ្ចឹម	Success of Seed Production	Total Amount of Fingerlings Produced in 2013	Problem of Seed Production
☐ Silver Barb ត្រីឆ្ពិន	☐ Yes ☐ No		
☐Common Carp ត្រីកាបមញ្ញ	☐ Yes ☐ No		
☐ Silver carp ត្រីកាបស	☐ Yes ☐ No		
☐ Murgal ត្រីម្រ័ហ្គាល់	☐ Yes ☐ No		
☐ Tilapia ត្រីទីឡាព្យា	☐ Yes ☐ No		
☐Other ផ្សេងៗ (_____)	☐ Yes ☐ No		

III. Extension Activities សកម្មភាពផ្សព្វផ្សាយ

Q1. How do you think of the following services of extension officers?

តើអ្នកគិតដូចម្តេចដែរ រាល់ការណែនាំបច្ចេកទេសរបស់មន្ត្រីផ្សព្វផ្សាយ ?

a) Technical advices

ការណែនាំផ្នែកបច្ចេកទេស

☐ Very Good ល្អណាស់, ☐ Good ☐ Common ☐ Bad

b) Communication with farming communities

ការទំនាក់ទំនងជាមួយសហគមន៍ចិញ្ចឹមត្រី

☐ Very Good ល្អណាស់, ☐ Good ☐ Common ☐ Bad

c) Facilitation for organizing farming communities or networks

ការសម្របសម្រួលសម្រាប់រៀបចំសហគមន៍ចិញ្ចឹមត្រី ឬបណ្តាញ

☐ Very Good ល្អណាស់, ☐ Good ☐ Common ☐ Bad

Q2. Are you satisfied at technical advices of extension officers in the following subjects?

តើអ្នកពេញចិត្តដែរឬទេ ពីការណែនាំរបស់មន្ត្រីផ្សព្វផ្សាយ ពីបច្ចេកទេស ដូចប្រធានបទខាងក្រោម?

Technical subject ប្រធានបទបច្ចេកទេស	1) Yes, much satisfied បាទ,ចាស ពេញចិត្តណាស់	2) Yes, but a little satisfied បាទ,ចាស ពេញចិត្ត	3) No, not satisfied ទេ, មិនពេញចិត្ត
Fish breeding ការបង្កាត់ភ្ញាស់ត្រី	☐	☐	☐
Pond preparation ការរៀបចំស្រះ	☐	☐	☐
Fish feed making ការផលិតចំណី	☐	☐	☐
Feeding management ការគ្រប់គ្រងចំណី	☐	☐	☐
Water quality control ការគ្រប់គ្រងគុណភាពទឹក	☐	☐	☐
Fish disease treatment ការការពារជម្ងឺត្រី	☐	☐	☐

Annex 2: Interview Memo with Core Farmers

Siem Reap Province (1)

	Name: Say Sorn	Visit Date: August 13, 2014
	Commune: Puok	District: Puok
	1st Year Core Farmer (2011)	Province: Siem Reap

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	Total 180,000 (mostly Silver Barb)	Water quality is not good (dirty, polluted by pesticide)
Tilapia		No technical problem. Produce only small amount, because of small market demand.
Common Carp		Fingerlings do not grow at same size at nursery stage.
Murgal		No technical problem. Produce only small amount, because of small market demand
Climbing Perch		Seed production is very easy. Fingerlings grow fast.
Catfish		Difficult to rear fish fries after hatching; especially, feeding for fish larva and fingerlings.
Frog	-	Start a production this year.

Other Condition / Problem:
- Some broodstock were lost by flood last year (2013).
- The marketing of Climbing Perch, Silver Barb and Catfish is good locally.

Comment / Suggestion:
- He hopes fisheries office / project to help more farmers to produce more fish seeds.
- He needs more trainings for new seed producers.

	Name: Yip Prang	Visit Date: August 13, 2014
	Commune: Kandaek	District: Prasat Bakong
	1st Year Core Farmer (2011)	Province: Siem Reap

Fish Species	Production (2013)	Production Condition / Problem
Tilapia (red)	270,000	No technical problem.
Catfish	400,000	Its market is good.

Other Condition / Problem:
- The quantity of water supply is not enough. He always waits for raining at dry season.

Comment / Suggestion:
- He expects fisheries office / project to provide more support, such as technical training, study tour, etc.
- He wants to learn something new, such as new species, new breeding skill, etc.

Siem Reap Province (2)

	Name: Puok Chhorn	Visit Date: August 13, 2014
	Commune: Spean Thnot	District: Chi Kraeng
	1st Year Core Farmer (2011)	Province: Siem Reap

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	80,000	No technical problem.
Tilapia	90,000	No technical problem. Climate change (hot temperature, no raining) disturbs production.
Common Carp	10,000	No technical problem. Hot temperature disturbs spawning.
Murgal	10,000	Low demand at local market.
Silver Carp	5,000	Low demand at local market.
Catfish	-	Start a production this year. Target production is 40,000.

Other Condition / Problem:
- The farm has never suffered flood.
- Small market demand is the largest problem. Most local people do not know how to culture fish.

Comment / Suggestion:
- He expects fisheries office / project to continue supporting fish farmers.
- He also hopes to develop more fish farmers for new fish seed market.

	Name: Mao Lanh	Visit Date: August 13, 2014
	Commune: Samraong	District: Soutr Nikom
	1st Year Core Farmer (2011)	Province: Siem Reap

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	107,200	No technical problem.
Tilapia	60,000	Low survival rate in nursery stage.
Common Carp	10,000	Low survival rate in nursery stage.
Murgal	10,000	No technical problem.
Climbing Perch	10,000	Low survival rate in nursery stage.
Catfish	-	Start a production this year. Already produced 15,000 this year (2014).

Other Condition / Problem:
- The most serious problem is marketing of fingerlings. Only project farmers purchase fingerlings.
- The quantity of water supply is not enough, due to dependence of rainwater. Water quality is good.

Comment / Suggestion:
- He expects fisheries office to support his seed production activity and develop fish seed market after the completion of the project.

Siem Reap Province (3)

	Name: Met Nimul	Visit Date: August 13, 2014
	Commune: Dan Run	District: Soutr Nikom
	2nd Year Core Farmer (2012)	Province: Siem Reap

Fish Species	Production (2013)	Production Condition / Problem
Tilapia	4,000	Most broodstock and fingerlings were lost by flood.

Other Condition / Problem:
- He rents the land of fish farm to a private company of mineral water. He has stopped working for fish culture.
- At present, he tries to select a good place for fish culture. He hope to resume fish culture next year.

Comment / Suggestion:
- He needs additional trainings of seed production for new species.

	Name: Neuv Noeun	Visit Date: August 14, 2014
	Commune: Dan Run	District: Soutr Nikom
	2nd Year Core Farmer (2012)	Province: Siem Reap

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	10,000	Water quality is not good (dirty). Water quantity is also not enough.
Tilapia	5,000	Water quality is not good (dirty). Water quantity is also not enough.
Common Carp	10,000	Low demand at local market.

Other Condition / Problem:
- Some broodstock escaped by flood last year.
- He does not produce fish seeds this year, because I lost most of female fish. Remaining female fish are still small for breeding.

Comment / Suggestion:
- He hopes the project to support additional training program for new species and new breeding technique.

Siem Reap Province (4)

Name: Lach Chummitn	Visit Date: August 14, 2014
Commune: Doun Peng	District: Angkor Chum
3rd Year Core Farmer (2013)	Province: Siem Reap

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	-	Water quality is not good for breeding (dirty).
Tilapia	90,000	Raining comes late this year. It disturbs seed production.
Common Carp	-	Water quality is not good for breeding (dirty).
Murgal	-	Water quality is not good for breeding (dirty).
Silver Carp	-	Water quality is not good for breeding (dirty).

Other Condition / Problem:
- Hatchery facility was not completed last year. Therefore, he could not start seed production except Tilapia.
- This year, it is difficult to sell fingerlings until now, because only a few farmers come to buy them.

Comment / Suggestion:
- In future, fisheries office will establish a feed factory to provide certified quality fish feeds to local farmers. He does not believe the quality of private brand feeds.

Name: Heang Hoksom	Visit Date: August 14, 2014
Commune: Peak Snaemg	District: Angkor Thum
2nd Year Core Farmer (2012)	Province: Siem Reap

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	70,000	No technical problem. Marketing is also good. This year, already produced about 100,000 fingerlings.
Common Carp	20,000	Low demand. Not many farmers come to buy fingerlings.

Other Condition / Problem:
- Broodstock of other species (Murgal, Silver Carp, Catfish, Climbing Perch and Pangasius) were lost by flood last year.
- Due to small demand, common carp seeds are not produced this year.

Comment / Suggestion:
- He hopes to get more chance to join a training of foreign countries to learn more techniques.

Siem Reap Province (5)

	Name: Penh Puth	Visit Date: August 14, 2014
	Commune: Tbeng	District: Banteay Srei
	2nd Year Core Farmer (2012)	Province: Siem Reap

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	5,000	Low survival rate at nursery stage in concrete tanks. It may be caused by water quality.
Tilapia	3,000	Broodstock is still small.
Common Carp	5,000	Low survival rate at nursery stage in concrete tanks.
Silver Carp	-	He keeps broodstock; but he does not know a proper spawning skill.

Other Condition / Problem:
- This year, he uses underground water for breeding instead of pond water. Its result is better than last year.
- Not many famers ask to produce fish seeds.
- In 2011, all broodstock were lost by flood.
- Not enough labor to support field works for fish seed production.

Comment / Suggestion:
- No idea.

Battambang Province (1)

Name: Chhorm Sovan	Visit Date: August 5, 2014
Commune: Voat Kor	District: Battambang
1st Year Core Farmer (2011)	Province: Battambang

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	23,000	No technical problem. High demand in market
Tilapia (red & black)	19,000	No technical problem.
Common Carp	10,200	No technical problem. High price in market
Murgal	-	Produce fingerling according to farmers' orders.
Silver Carp	-	Difficult to produce fingerling at nursery stage.
Walking Catfish	-	No technical problem. But, difficult to keep water for production
Pangasius	-	Broodstock is still small. Try to produce seed this year.
Rohu	-	Able to produce fingerling.

Other Condition / Problem:

Comment / Suggestion:
- After joining the project, he learned many skills and improve his livelihood. If possible, fisheries office continues helping our activities.

Name: Chounm Thin	Visit Date: August 5, 2014
Commune: Ou Mal	District: Battambang
2nd Year Core Farmer (2012)	Province: Battambang

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	40,000	No technical problem.
Tilapia (black)	10,000	No technical problem.
Common Carp	10,000	Low survival rate in breeding.
Murgal	-	Broodstock is still small.
Silver Carp	-	Broodstock is still small.

Other Condition / Problem:
- Silver Carp and Murgal bloodstock, provided by the project, escaped by flood last year. He bought bloodstock by himself. However, the broodstock is still small for breeding.

Comment / Suggestion:
- If possible, the project will provide good quality broodstock again.

Battambang Province (2)

	Name: Roum Chen	Visit Date: August 6, 2014
	Commune: Lvea	District: Bavel
	3rd Year Core Farmer (2013)	Province: Battambang

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	75,000	No technical problem.
Tilapia (red & black)	-	No technical problem.
Murgal	-	Only a few broodstock.

Other Condition / Problem:
- Most produced fingerling escaped by flood last year. Only 5,000 silver barb fingerlings were sold.

Comment / Suggestion:
- If possible, the project will provide an oxygen tank and a pelleting machine.

	Name: Mith Phan	Visit Date: August 6, 2014
	Commune: Prey Khpos	District: Bavel
	1st Year Core Farmer (2011)	Province: Battambang

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	40,000	Technique is easy. But, low survival rate at larva / fry nursery stage
Tilapia (red & black)	15,000	No technical problem.
Common Carp	10,000	Weak stick eggs. Broodstock spawns only small amount of eggs.
Murgal	35,000	No technical problem.

Other Condition / Problem:
- Most produced fingerling escaped by flood last year. Only 40,000 fingerlings (mix species) were sold to farmers.

Comment / Suggestion:
- If possible, fisheries office will extend the number of fish farmers, for example, increasing up to 30 - 40 fish famers in a commune.

Battambang Province (3)

	Name: Mao Pek	Visit Date: August 6, 2014
	Commune: Bansay Taeng	District: Thma Koul
	1st Year Core Farmer (2011)	Province: Battambang

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	230,000	No technical problem. However, not enough water in breeding period.
Tilapia (red & black)	87,000	No technical problem. However, not enough water in breeding period.
Common Carp	6,000	No technical problem. However, not enough water in breeding period.

Other Condition / Problem:
- Fish fries grow slow, because of a shortage of pond water (April to July) by now raining. Fish ponds are so swallow.
- Difficult to sell fish fries now, because of lack of water in local farmers' ponds.
- The farm was suffered from flood in October 2013.

Comment / Suggestion:
- Thank you for the project. He got much ideas and experiences in training program.

	Name: Phal Veasna	Visit Date: August 6, 2014
	Commune: Anlong Run	District: Thma Koul
	2nd Year Core Farmer (2012)	Province: Battambang

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	170,000	No technical problem. Not enough pond water for fry nursery.
Tilapia (black)	35,000	No technical problem. Low water level in ponds in dry season. Broodstock is still small
Common Carp	15,000	No technical problem. Difficult to sell fries at market. Low demand.
Murgal	20,000	Not enough water for breeding.
Silver Carp	-	Not succeed seed production. All broodstock escaped by flood in Sep. 2013.
Walking Catfish	-	Try to produce fries this year.

Other Condition / Problem:
- The farm was suffered from the flood in September 2013. Most of broodstock and fingerlings were lost by flood. Only remaining fingerlings (40,000 of Silver Bard and 4,500 of Common Carp) were sold after the flood.

Comment / Suggestion:
- He wants to learn more breeding skill, for example, how we define good quality broodstock.
- He may need to set floating cages for stocking broodstock and fingerlings to avoid getting damage by flood.

Battambang Province (4)

Name: Suon Pan	Visit Date: August 6, 2014
Commune: Ou Ta Ki	District: Thma Koul
2nd Year Core Farmer (2012)	Province: Battambang

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	30,000	No technical problem. Not enough pond water for fry nursery.
Tilapia (red & black)	15,000	No technical problem. Not enough pond water for fry nursery. Red color tilapia has high market demand.
Common Carp	5,000	No technical problem. Not enough pond water for fry nursery.
Murgal	-	No production. Not enough pond water for fry nursery.
Silver Carp	-	Difficult to find local market.

Other Condition / Problem:
- Sometime, he takes water from litigation canals for fishponds. However, the water from paddy fields is contaminated with pesticide.
- Except Silver carp, the marketing of target fish species is good.

Comment / Suggestion:
- He may need a solar system for breeding work at night, because of no electricity supply.

Name: Lem Pakdewalt	Visit Date: August 6, 2014
Commune: Chrey	District: Thma Koul
2nd Year Core Farmer (2012)	Province: Battambang

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	108,500	No technical problem. Difficult to nurse fries in ponds. Larva are very small.
Tilapia (red & black)	10,000	Broodstock escaped by flood last year.
Common Carp	25,000	Many insects are in ponds. Fish larvae gradually disappear in ponds.
Murgal	-	Broodstock is still small.
Silver Carp	-	Water temperature often changes in ponds. It breaks spawned eggs.
Cat Fish	-	Start to produce the fries this year.

Other Condition / Problem:
- The flood washed away brookstock last year. Only a little broodstock of Silver Barb and Tilapia remain at the farm.
- It is difficult to sell fish fingerlings to local farmers, because most farmers are afraid of a flood again this year.

Comment / Suggestion:
- He wants to learn Pangasius breeding, because Pangasius is popular at local market now.

Battambang Province (5)

	Name: Sam Thim	Visit Date: August 7, 2014
	Commune: Prey Touch	District: Moung Ruessei
	1st Year Core Farmer (2011)	Province: Battambang

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	23,000	No technical problem. Not enough water for breeding. It is very hot recently.
Tilapia (red & black)	19,000	Easy to produce the seeds.
Common Carp	10,200	Male broodstock was lost by flood.
Murgal	3,500	No technical problem.
Silver Carp	-	Not produced fries yet.

Other Condition / Problem:
- It is hard to find / get hormone agents for injection.

Comment / Suggestion:
- He wants to get a pelleting machine for making home-made compounded feeds.

	Name: Chen Khon	Visit Date: August 7, 2014
	Commune: Prey Svay	District: Moung Ruessei
	3rd Year Core Farmer (2013)	Province: Battambang

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	50,000	No technical problem. However, some broodstock escaped by flood last year.
Tilapia (red & black)	-	Some broodstock escaped by flood last year.
Common Carp	-	All broodstock escaped by flood last year.
Murgal	-	Some broodstock escaped by flood last year.
Silver Carp	-	All broodstock escaped by flood last year.
Catfish	-	Collect wild fish as broodstock.

Other Condition / Problem:
- Silver Barb, Tilapia, and Catfish have high demands at local markets.
- Lack of water in breeding time.

Comment / Suggestion:
- No more comment.

Battambang Province (6)

Name: Um Khoen	Visit Date: August 7, 2014
Commune: Muk Rea	District: Rukhak Kiri
3rd Year Core Farmer (2013)	Province: Battambang

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	-	Some problem for nursery and feeding for fish fries.
Tilapia (red & black)	27,000	Easy to produce the seeds.
Common Carp	-	No technical problem.
Murgal	-	Not tried to produce yet.
Silver Carp	-	After injection and spawning, eggs could not hatch.
Catfish	-	Low survival rate (about 30 %). Broodstock is also still small.

Other Condition / Problem:
- Some broodstock was lost by flood last year.
- Marketing of fish fries is easy.

Comment / Suggestion:
- If possible, he want to get a training for reviewing breeding skills.
- He hopes to continue making a cooperation with extension staffs.

Pursat Province (1)

Name: Ya Samnang	Visit Date: August 7, 2014
Commune: Snam Preah	District: Bakan
3rd Year Core Farmer (2013)	Province: Pursat

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	-	Broodstock is still small, not mature yet.
Tilapia (red & black)	8,000	No technical problem.
Common Carp	6,000	No technical problem.
Murgal	-	Broodstock has not been mature yet.
Silver Carp	-	Broodstock has not been mature yet.

Other Condition / Problem:
- It is easy to sell fingerling to local farmers.
- Flood comes there sometime.

Comment / Suggestion:
- He hopes to join a study visit to foreign country in future.

Name: Chin Kunthy	Visit Date: August 7, 2014
Commune: Trapeang Chorng	District: Bakan
2nd Year Core Farmer (2012)	Province: Pursat

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	100,000	No technical problem.
Tilapia (red & black)	50,000	No technical problem.
Common Carp	110,000	No technical problem.
Murgal	30,000	Spawning is not good this year, because water temperature is high.
Silver Carp	20,000	Spawning is not good this year, because water temperature is high.
Catfish	-	Not produced yet. He will try to produce fries after selling all fingerlings.

Other Condition / Problem:
- It was easy to sell fingerlings last year, because fishponds had enough water in this season. However, this year, the ponds do not have enough water for farming fish.
- Now, he does not have enough nursery ponds to produce more fingerlings.

Comment / Suggestion:
- He wants to know how to check the water quality, such as pH, DO, etc.

Pursat Province (2)

	Name: Sou Yeng	Visit Date: August 8, 2014
	Commune: Rumlech	District: Bakan
	2nd Year Core Farmer (2012)	Province: Pursat

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	10,000	No technical problem. Water quality is not good for fish breeding.
Tilapia (red & black)	8,000	No technical problem. Water quality is not good for fish breeding.
Common Carp	-	Broodstock is still small, has not been mature yet.
Murgal	-	Broodstock has not been mature. He tried to inject them, but they did not spawn eggs.
Catfish	-	Not tried to produce yet.

Other Condition / Problem:
- Due to flood, he lost some broodstock of Tilapia and Silver Barb last year.
- The main problem of this year is a shortage of water in fishponds.

Comment / Suggestion:
- He wants to get a training program on Murgal and Catfish breeding.

	Name: Phon Chea	Visit Date: August 8, 2014
	Commune: Khnar Totueng	District: Bakan
	1st Year Core Farmer (2011)	Province: Pursat

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	More than 10,000	Fingerlings grow slow, because of broodstock quality and nursing condition.
Tilapia (black)	More than 10,000	No technical problem.
Common Carp	-	Broodstock is still small for breeding.
Silver Carp	-	Broodstock is still small for breeding. When trying for breeding before, it is very low survival rate.
Catfish	-	Low survival rate, because of water quality and no aeration.

Other Condition / Problem:
- Some broodstock escaped by flood in October 2013.
- Marketing of fish fingerlings is not a problem last year. This year, it is not easy to sell fingerlings, because fishponds do not have enough water for fish culture.

Comment / Suggestion:
- He needs a solar panel and battery for stable aeration for breeding.

Pursat Province (3)

Name: Chhea Chheng	Visit Date: August 8, 2014
Commune: Phteah Rung	District: Phnum Kravanh
3rd Year Core Farmer (2013)	Province: Pursat

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	20,000	No technical problem. Not enough water for breeding.
Tilapia (black)	-	20,000 fingerlings has been produced this year.
Common Carp	30,000	No technical problem. Not enough water for breeding.
Murgal	-	Broodstock is still small for breeding.

Other Condition / Problem:
- This year, there are not enough water in farmers' ponds. All nursery ponds are full of fingerlings.
- He consider improving techniques for breeding and nursery.
- Water quality may not be good for breeding. He plans to dig a deep well for water supply.

Comment / Suggestion:
- He wants to dig a deep well to take underground water.

Name: Phat Saroeun	Visit Date: August 21, 2014
Commune: Svay Sa	District: Krakor
4th Year Core Farmer (2014)	Province: Pursat

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	1,000	After injection, some broodstock did not spawn eggs, and some were dead.
Tilapia	500	No technical problem. Grow so fast.
Common Carp	1,000	Most fingerlings disappeared in ponds at nursery stage.

Other Condition / Problem:
- He will raise all produced fingerlings by himself for future broodstock and grow-out for food.
- After temperature suddenly dropped in raining after long hot days, some Silver Barb fingerlings were dead in ponds

Comment / Suggestion:
- He wants to learn more breeding and nursing skills.

Pursat Province (4)

Name: Srei Monynal	Visit Date: August 21, 2014
Commune: Tnaot Chum	District: Krakor
2nd Year Core Farmer (2012)	Province: Pursat

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	4,000	No technical problem.
Tilapia	10,000	Ne technical problem.
Common Carp	-	He bought new broodstock this year.
Murgal	20,000	He have only 5 broodstock (female 2, male 3).
Catfish	-	He bought new broodstock this year.

Other Condition / Problem:
- This year, not enough water in nursing ponds. Therefore, he cannot produce more fingerlings in spite of local demand.
- Murgal and Tilapia are not popular at this area.
- He got flood last year, and lost some fingerlings.

Comment / Suggestion:
- He wants to dig a deep well for taking underground water for breeding. He should 50m deep at least.

Name: Kean Nhoeng	Visit Date: August 21, 2014
Commune: Kaoh Chum	District: Kandieng
1st Year Core Farmer (2011)	Province: Pursat

Fish Species	Production (2014)	Production Condition / Problem
Silver Barb	150,000	No technical problem.
Tilapia	10,000	No technical problem.
Common Carp	30,000	No technical problem.
Murgal	-	No technical problem. Not produced yet, because of shortage of pond water.
Silver Carp	-	After injection, sometime, broodstock cannot spawn eggs. He does not know what problem it is, for example, hormone dosage, broodstock selection, etc.
Catfish	5,000	No technical problem.

Other Condition / Problem:
- He could not produce fish seeds last year, because he lost many broodstock by flood and was busy for general election as cantonment chief.
- In case of Tilapia, Silver Barb, Common Carp and Catfish, it is easy to finds customers. However, in case of Murgal and Silver Carp, it is difficult to find customers.

Comment / Suggestion:
- If possible, another project will continue support technical matters. He wants to learn new breeding skills for improving survival rate.

Pursat Province (5)

	Name: Soeum Chouch	Visit Date: August 21, 2014
	Commune: Ou Ta Pang	District: Bakan
	4th Year Core Farmer (2014)	Province: Pursat

Fish Species	Production (2014)	Production Condition / Problem
Silver Barb	10,000	No technical problem.
Tilapia	10,000	No technical problem.
Common Carp	-	No technical problem. If water is enough in ponds, he will start to produce.
Silver Carp	-	No plan to produce.
Catfish	-	No technical problem. If water is enough in ponds, he will start to produce.

Other Condition / Problem:
- The water in ponds is not enough now. Therefore, he cannot produce more seeds.
- In Silver Barb, Tilapia, Common Carp and Catfish, it is easy to find customers. However, in Silver Carp and Murgal, it is difficult to find customers.

Comment / Suggestion:
- He wants to learn new breeding techniques and compare current techniques.
- He wants to get a large-capacity battery for aeration to improve survival rate.

	Name: Ly Heng	Visit Date: August 22, 2014
	Commune: Kauhchor	District: Kandieng
	1st Year Core Farmer (2011)	Province: Pursat

Fish Species	Production (2013)	Production Condition / Problem
Silver Barb	10,000	No technical problem.
Tilapia	10,000	No technical problem.
Common Carp	20,000	No technical problem.
Murgal	-	Some broodstock were dead. This year, 10,000 fingerlings have been produced.

Other Condition / Problem:
- Water quality is fine for breeding.
- Small aquatic insects often eat fingerling in ponds at nursery stage. He try to kill them by spraying lime in ponds. It is effective.
- Sometime, it is difficult to find customers, because most fish farmers are placed at up-land area. His farm is far from them.

Comment / Suggestion:
- To avoid losing fish by flood, he wants to dig channels around the fish farm and make dikes by dug soils.

Pursat Province (6)

	Name: Chea Chamman (Ouk Kuong)	Visit Date: August 22, 2014
	Commune: Leach	District: Phnum Kravanh
	3rd Year Core Farmer (2013)	Province: Pursat

Fish Species	Production (2014)	Production Condition / Problem
Silver Barb	2,000	No technical problem.
Tilapia	-	Broodstock is stll small for breeding.
Common Carp	3,000	No technical problem. 2,000 fingerlings were produced last year (2013).
Murgal	-	Broodstock is stll small for breeding.
Silver Carp	-	Broodstock is stll small for breeding.

Other Condition / Problem:
- He wants to produce Tilapia fingerlings. However, fishponds do not have enough water for breeding. He needs dig more ponds to secure water sources.
- He does not have a harvest net. He always borrow it from other farmer when harvesting.

Comment / Suggestion:
- If possible, the project will provide good quality broodstock for future production. He got broodstock from other core famers last year.
- He wants to get a water pump to spray water in ponds for supplying oxygen.

	Name: Korm Thiv	Visit Date: August 22, 2014
	Commune: Roleab	District: Pursat
	3rd Year Core Farmer (2013)	Province: Pursat

Fish Species	Production (2014)	Production Condition / Problem
Silver Barb	7,000	No technical problem.
Tilapia	3,000	No technical problem.
Common Carp	3,000	No technical problem. Sometime, grow so slow when nursing fingerlings in ponds.
Silver Carp	-	Broodstock is still small for breeding.

Other Condition / Problem:
- The number of produced fingerlings is still small.
- The sale of fingerling may not be problem.

Comment / Suggestion:
- Currently, feed price gets higher; but fish price gets lower. Fish culture may not make good benefit.

ANNEX 5

(Final Report)

Extension guideline

Guideline on Aquaculture Extension

Freshwater Aquaculture Improvement and Extension Project in Cambodia, Phase 2 (FAIEX-2)

Fisheries Administration in Cambodia

Japan International Cooperation Agency

August 2014

Preface

The people of Cambodia have been consuming abundant freshwater fishes as a local protein source. However, overfishing and environmental deterioration in freshwater bodies such as lakes and rivers have decreased the catch amount of freshwater fishes. In addition, the rapid increase of the national population may render insufficient the supply of freshwater fishes at local markets. Therefore, the local prices of freshwater fish products have gradually increased.

To utilize properly freshwater fisheries resources as precious sources of animal protein and income, maintain food security, and improve livelihoods in rural areas, it is essential to have local communities engage in freshwater fish culture and promote community fisheries activities. This guideline on aquaculture extension summarizes the following: (1) objectives and issues of aquaculture extension; (2) structure and functions on aquaculture extension; (3) tasks of extension officers; (4) strategy for sustainable aquaculture extension; (5) necessary skills and techniques for aquaculture extension; and (6) visions for aquaculture extension. Those contents are based on the experiences and practices of the Freshwater Aquaculture Improvement Extension Project (FAIEX).

We hope that the agencies and organizations engaging in aquaculture extension, especially the Fisheries Administration, will utilize this guideline to discuss issues and find a proper direction on aquaculture extension in Cambodia.

August 2014

Contents

1. Purpose of Aquaculture Extension for Rural Communities

Aquaculture is one of the important livelihood activities for people in rural areas to produce animal protein and earn additional income. Applied aquaculture techniques and skills should be widely disseminated to the rural areas in Cambodia so that the people in the areas can secure food sources, generate income, and promote networks among themselves. Therefore, aquaculture extension services are expected to contribute to improving food security and living standards of rural communities.

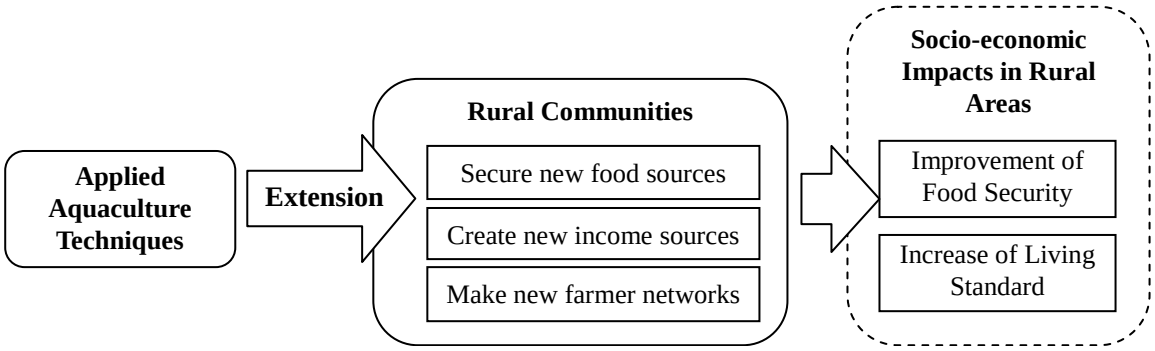


Figure 1: Image of Socio-Economic Impacts of Aquaculture Extension

2. Main Issues in Aquaculture Extension

Based on the current situation of aquaculture development in Cambodia, the following are the main issues in aquaculture extension activities.

1. Strengthening the Capacities of Extension Officers and Technical Personnel Responsible for Aquaculture

It is necessary to train aquaculture extension officers regularly and improve their capacities. The technical and extension skills of the extension officers and the technical personnel tend to be outdated because they have few opportunities to acquire improved aquaculture techniques and skills.

2. Structure for Managing Aquaculture Extension

It is necessary to establish a clear administrative structure and a division of labor for aquaculture extension among the Fisheries Administration, local fisheries offices, and fish farmers. The aquaculture extension services to local communities, such as regular visits for technical advice, coordination of fish seed supply, and promotion of organizations and

networks of farmers, have been neither effective nor efficient because aquaculture extension has neither a clear administrative structure and nor a division of labor.

3. Strengthening the Capacity of Fish Seed Producers (Core Farmers)

Sufficient and stable supply of fish seeds for local farmers is essential to promote fish culture production in rural areas. However, the capacity of fish seed production in government hatcheries is too limited to cover fish seeds that the local farmers need. Therefore, potential fish farmers must be trained to become fish seed producers, who supply fish seeds to local farmers in their communities. Moreover, they are expected to be “core farmers” in aquaculture extension at the community level. The number of skilled seed producers might be too limited to meet the future demand for fish seeds in Cambodia. In addition, most seed producers have trouble producing fish seeds sufficiently and stably. Accordingly, the government authorities should conduct proper extension programs to strengthen the technical and management capacities of existing and future seed producers.

4. Organizing Networks of Fish Seed Producers and Fish Grow-out Farmers

It is important to help fish farmers form networks at the community level. The manpower of government agencies such as the Fisheries Administration and provincial governments is too limited to support all potential areas and fish farmers through aquaculture extension services. To disseminate appropriate aquaculture skills and techniques nationwide, the networks of fish farmers should be utilized effectively at the community level.

3. Basic Structure of Aquaculture Extension

Aquaculture extension activities should be carried out under the coordination of the Fisheries Administration. All organizations and personnel engaged in aquaculture extension should perform their respective roles properly. The key actors in aquaculture extension on the government side are the Department of Aquaculture Development in the Fisheries Administration, the Seed Production Centers, and the Cantonment Fisheries Offices. Fish seed producers and local fish farmers should serve as local promoters of aquaculture extension.

Based on the status of aquaculture extension in Cambodia, the implementation structure shown in Figure 2 can be applied to promote aquaculture techniques to rural communities.

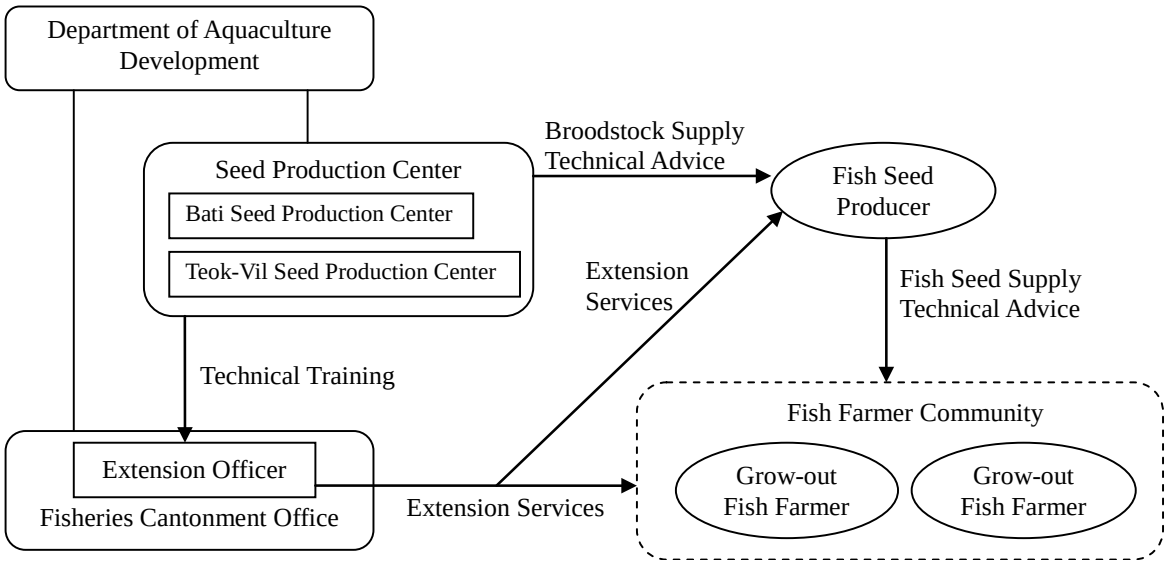


Figure 2: Basic Implementation Structure of Aquaculture Extension

Here are the main roles of the government organizations in aquaculture extension.

i) Department of Aquaculture Development, Fisheries Administration

The department is responsible for coordinating aquaculture extension programs with the Seed Production Centers and the Cantonment Fisheries Offices. The department's personnel visit the centers and the offices on a regular basis to monitor and support their extension and field activities on technical and management aspects.

ii) Seed Production Centers

The FAIEX project helped rehabilitate and improve two Seed Production Centers for freshwater aquaculture in Cambodia. One is the Bati Center in Prey Province, and the other is the Teok-Vil Center in Siem Reap Province. Both centers are responsible for developing and improving applied techniques for seed production and grow-out culture, and helping

extension officers acquire advanced aquaculture skills and knowledge.

iii) Cantonment Fisheries Offices

The Cantonment Fisheries Offices are responsible for carrying out field activities in aquaculture extension. In the activities, extension officers of the offices play important roles such as on-farm technical guidance and coordination of fish seed supply. The next chapter describes the tasks of the extension officers.

In addition, the Fisheries Administration should train fish farmers who are highly motivated and implement good practices in fish culture as “core farmers” to produce and supply a sufficient amount of fish seeds at the community level. As community-based extension personnel, the core farmers play an important role in extending fish culture techniques to other local farmers.

4. Tasks of Extension Officers for Aquaculture Extension

Extension officers in charge of aquaculture development should be responsible for the following activities to promote small-scale fish culture in rural communities.

4-1. Technical Advice to Farmers

Regarding technical advice to fish farmers, a technical training course and an extension visit to farmers should be carried out as a package. A few days' training program can help local farmers acquire basic knowledge and skills of fish culture; however, it may not lead them to implement aquaculture practices immediately. Therefore, follow-up activities to the farmers who took part in the training are very important in encouraging them to execute aquaculture operations. Extension officers should visit farmers at least once or twice a month to advise them on technical skills in the field. In such visits, the officers should also monitor aquaculture conditions and operations because the environmental and management conditions of aquaculture keep changing. The officers' visits also help maintain and boost the farmers' morale on aquaculture practices.

On-farm guidance is important for giving proper technical advice and suggestions to fish farmers, especially new ones.

Technical training programs on fish grow-out culture are often held through cooperation between the Fisheries Administration and core farmers (fish seed producers).

4-2. Information Collection from and Dissemination to Farmers

Environmental factors, such as climate and water conditions, and social factors in farmers' communities often affect aquaculture practices. Moreover, fish farmers always seek the latest information on aquaculture techniques to improve their operations, because most of them live in remote areas. To find out issues facing fish farmers and consider how best to address the issues, extension officers collect information on aquaculture operations from local farmers by interviews or workshops, and disseminate appropriate skills and techniques to farmers by

such tools as posters and leaflets.

Extension officers visit fish farmers regularly to grasp the status of fish culture activities.

Technical booklets and calendars are useful tools to provide proper information on fish culture activities to fish farmers.

4-3. Support to Distribute Fish Seeds and Arrange Fish Seed Production and Supply

In rural areas, supply routes of fish seeds have not been developed. Therefore, fish seed producers do not know where farmers interested in aquaculture are located. Similarly, the farmers interested in aquaculture do not know where they can purchase fish seeds. Therefore, the extension officers should serve as a bridge between fish seed producers and fish farmers to ensure smooth distribution of fish seeds. To avoid overproduction of fish seeds while preventing shortage of fish seed supply to fish farmers, the extension officers should also arrange fish seed production and supply in rural areas.

Extension officers arrange to supply fish seeds to local farmers in cooperation with fish seed producers.

After the supply of fish seeds, local farmers stock fish seeds at their ponds.

4-4. Coordination with Relevant Organizations

To disseminate proper information and skills of small-scale aquaculture effectively, it is essential to work closely with relevant government organizations, NGOs, and donor agencies. A linkage with local authorities such as provincial governments is particularly important to promote aquaculture extension activities at the field level. In aquaculture extension activities, extension officers should take charge of coordination with local authorities.

4-5. Support for Forming Fish Farmers' Networks

As mentioned above, networks of local fish farmers help promote extension activities at the grassroots' level. Utilizing such approaches for promoting farmers' networks as participatory workshops, study tours, and extension seminars, extension officers help fish farmers form networks and carry out aquaculture extension activities with the networks.

Experiences of existing network activities in fish seed producers are often shared with other farmers. (lecture of farmers' networking, Takeo)

The Fisheries Administration helps fish seed producers form networks. (Meeting of seed producers' network in Pursat)

Based on the outcomes of the FAIEX project, it is fair to say that the flow of activities as shown in Figure 3 is practical for the extension of freshwater aquaculture in Cambodia.

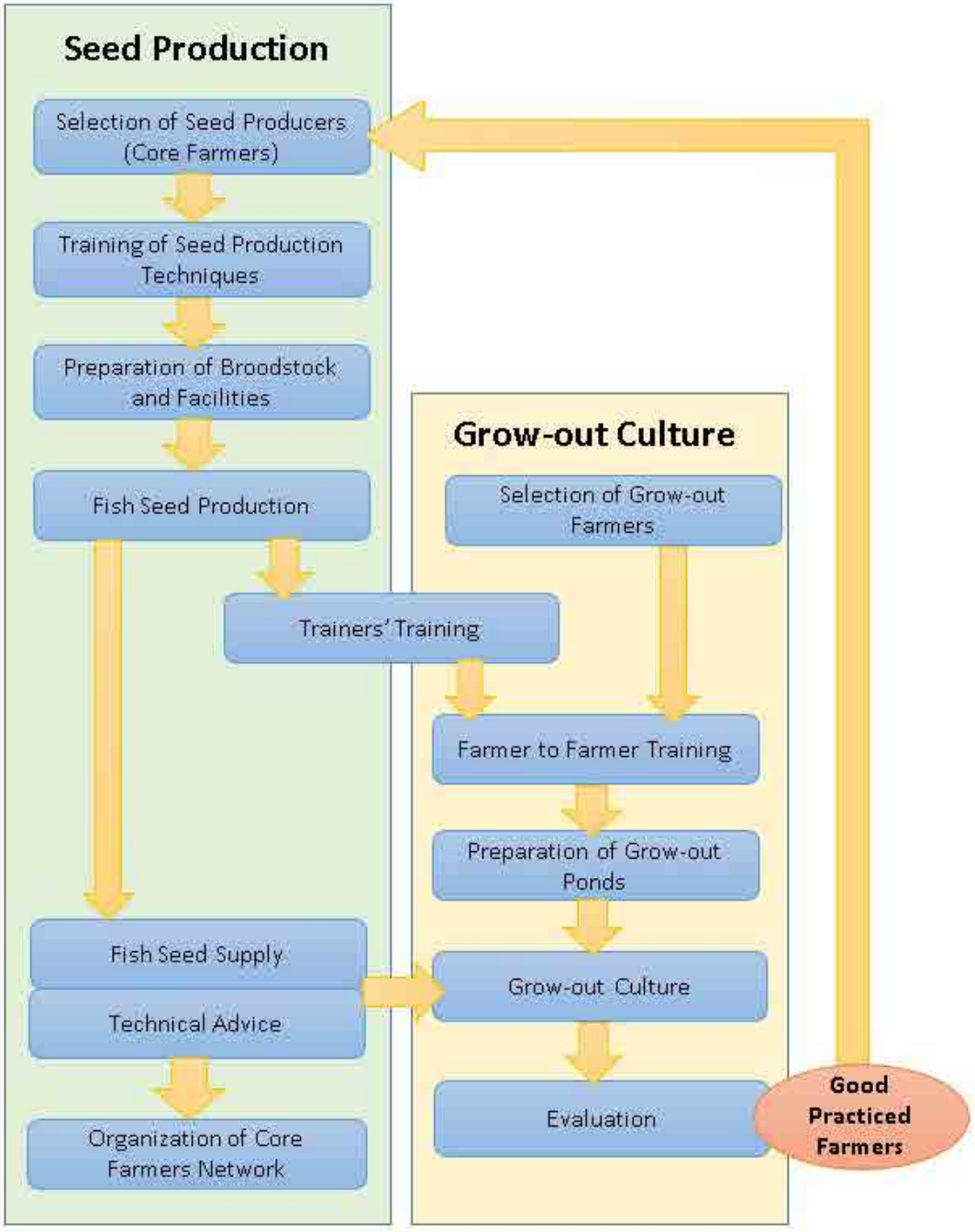


Figure 3: Basic Flowchart of Extension Activities on Freshwater Aquaculture

5. Strategy for Sustainable Aquaculture Extension

5-1. Selection of Target Communes and Farmers

The FAIEX project has proven that the farmer-to-farmer extension approach is effective for sustainable aquaculture extension in Cambodia. In this approach, fish farmers who are highly motivated and implement good fish culture practices will be trained as fish seed producers. They will be core farmers to train and advise other farmers in fish culture practices. To manage extension activities in this approach smoothly and effectively, it is important to select suitable farmers as core farmers through proper selection criteria.

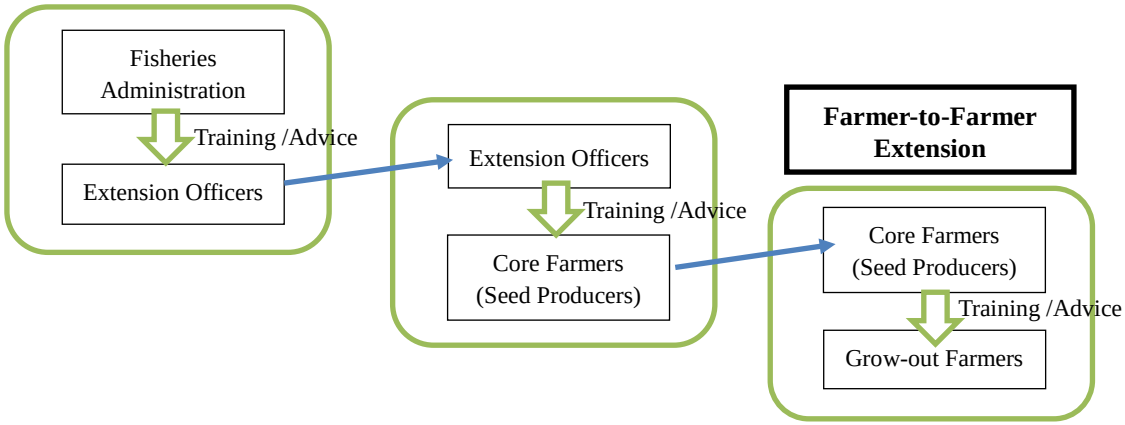


Figure 4: Image of the Farmer-to-Farmer Extension Approach

1) Selection of Target Communes

Field surveys will use the following criteria to select a few communes as target areas for fish culture extension.

Selection Criteria	Criteria Details
Economic Status	- The average community household income is lower than the national average.
Social Condition	- There is good communication among community people. - No conflicts or disputes from envy and jealousy have occurred. - There are no serious security problems such as thieves.
Environment for Fish Culture	- There are stable water sources for fish culture such as reservoir, well, and river. - Flood rarely occurs in the rainy season.
Preparation of Fish Culture	- Most people have their own pond for fish culture. - Most people can prepare animal manure and feed materials by themselves. - Most people can find and purchase fish seeds.
Accessibility to Community	- The condition of public roads and transportation is good. - Extension officers and core farmers can often visit ordinary farmers' places.
Community Motivation	- Most people are highly interested in fish culture. - Community leaders, or chiefs, are high motivated about fish culture.

2) Selection of Fish Seed Producers (Core Farmers)

The following are the criteria to select fish seed producers who are to be core farmers. The selection methods are interviews with and observation of fish farmers who implement fish culture well and are highly motivated about fish seed production.

Selection Criteria	Criteria Details
Experience on Fish Culture	- The farmer has basic skills of seed production or grow-out culture. - The farmer made good practices of fish grow-out culture.
Input Preparation	- The farmer has a fish pond, or an open land for one. - The farmer has some facilities and equipment for seed production. - The farmer has enough laborers for seed production activities, e.g., family members, relatives, and neighbors.
Water Availability	- The farmer is able to keep an enough amount of water for hatchery operation. - The farmer is able to secure an enough amount of water for nursery ponds in seed production.
Economic Status	- The farmer has no serious economic difficulties. - The farmer is able to invest in seed production facilities and equipment.
Motivation for Extension Services	- The farmer is highly motivated to be a core farmer for supplying fish seeds. - The farmer wants to share his or her fish culture techniques with other farmers.

3) Selection of Grow-out Farmers

The following are the criteria to select grow-out farmers out of fish farmers. The selection methods are interviews with and observation of potential farmers who are highly motivated about fish culture activities.

Selection Criteria	Criteria Details
Skills and Experience	- The farmer has learned or practiced fish grow-out culture.
Availability of Fish Ponds	- The farmer has a proper earthen pond, or has prepared a fish pond by himself or herself.
Water Availability	- The farmer's fish ponds can keep enough water for fish culture at least for six months a year. - The farmer has stable water sources for fish culture such as reservoir, river, and well.
Input Preparation	- The farmer has money for managing fish culture activities such as pond preparation, and purchase of fish seeds and fish feed. - The farmer is able to collect agriculture sub-products such as animal manure as feeds or fertilizers for fish culture.
Motivation	- The farmer and their families are highly interested in fish culture. - The farmer wants to share technical information with other farmers.

5-2. Capacity Development for Aquaculture Extension

1) Technical Training Program of Extension Officers and Core Farmers

To strengthen the technical skills of extension officers and core farmers for fish culture, the Fisheries Administration should hold regular training programs on fish seed production at seed production centers. Experiences in aquaculture extension and training vary among extension officers and core farmers. Thus, multiple training programs are needed to match their experiences and technical skills. The table below shows the types of possible training programs.

Possible Training Programs on Fish Seed Production
for Extension Officers and Core Farmers

Training Level	Elementary Level	Advanced Level
Trainees	- Extension officers in Cantonment, Sangkat or Division Fisheries Offices - New core farmers (Beginners in fish seed production)	- Extension officers with much experience in aquaculture extension - Experienced core farmers (Fish seed producers)
Outputs	1. Ability to advise fish farmers properly in on-site guidance	2. Ability to advise fish farmers and fish seed producers properly 3. Ability to manage extension activities properly at province level
Training contents	Lecture 1. Basic Aquaculture Techniques (Lecture) 2. Seed Production Techniques (Lecture) 3. Extension Methods	Lecture and Practice 1. Improved Aquaculture Techniques (Lecture and Practice) 2. Seed Production Techniques (Lecture and Practice) 3. Aquaculture Facilities and Management (Field trip to advanced areas)
Duration	One week	One week
Venue	Seed Production Center (Bati, Teok Vil)	Seed Production Center (Bati, Teok Vil)

The Bati and Teok Vil Centers are proper research stations for the extension officer training program, especially on seed production and grow-out culture techniques. The Bati Center should be responsible for technical extension in the eastern and southern regions of Cambodia, and the Teok Vil Center should cover the western and northern ones.

Study tours to the ponds of advanced fish farmers provide extension officers and core farmers an opportunity to learn about practical fish culture activities. (Takeo)

Practical training sessions on seed production let extension officers and core farmers acquire both basic and advanced techniques of fish culture. (Teok Vil Center, Siem Reap)

2) Training of Trainers (Core Farmers)

In the farmer-to-farmer extension approach, core farmers train other farmers in fish culture at the community level. Therefore, core farmers must have basic teaching skills to manage lectures as trainers in farmer-to-farmer training sessions. In the training of trainers, extension officers teach core farmers about the proper manners of presentation and discussion and the usage of training tools such as technical booklets, posters, and videos.

In training of trainers, extension officers advise core farmers on how to teach other farmers basic fish culture skills smoothly. (Siem Reap)

Materials such as posters are effective tools for farmer-to-farmer training. Core farmers learn to use training materials for farmer-to-farmer training sessions.

3) Farmer-to-Farmer Training

In farmer-to-farmer training sessions, core farmers teach other farmers basic skills on fish grow-out culture. The training sessions also help to form a close working relationship between core farmers and grow-out ones. The farmers' relationship will facilitate the delivery of fish seeds and on-site guidance to fish farmers.

In farmer-to-farmer training sessions, core farmers (fish seed producers) teach local farmers the basic skills of grow-out culture. (Siem Reap)

If necessary, extension officers also teach local farmers in farmer-to-farmer training sessions. (Battambang)

5-3. Organization of a Core Farmers' Network

A network among core farmers is expected to bring the following benefits for them. The Fisheries Administration must help the core farmers strengthen the capacity of their network.

1. Improvement of seed production techniques
   The network will promote close communication among core farmers by regular meetings and site visits to improve their seed production techniques.

2. Smooth sale and delivery of fish seeds
   The network will help core farmers arrange the sale and delivery of fish seeds smoothly.

3. Coordination of and request for technical and financial assistance
   The network will be a local representative association to request and coordinate technical and financial assistance for fish culture promotion from the government or donors.

To manage the network smoothly, core farmers will select members of the management board that consists of president, vice-president, secretary, treasurer, and execute members. In addition, they will prepare by-laws of the board for managing network activities, and register the network with the government as an official organization.

Core farmers attend network meetings regularly to exchange ideas on seed production operation. (Siem Reap)

Fisheries Administration officials help strengthen the capacity of the core farmers' network.

5-4. Necessary Skills for Extension Activities

To strengthen the capacity for aquaculture extension, extension officers must understand the following techniques and skills in their training programs and day-to-day work.

5-4-1. Techniques of Fish Culture

To extend fish culture activities in rural communities, the FAIEX project targeted the following five species of freshwater fish: common carp, silver carp, silver barb, murgal, and tilapia. In addition, based on demand in local markets, the project should target other species for aquaculture extension such as freshwater prawn (*Macrobrachium rosenbergii*), African catfish (*Clarias spp.*), and *Pangasius*.

a) Seed Production Techniques

The FAIEX project developed and improved the seed production techniques for target fish species. Regarding those species, extension officers must acquire the standard techniques of seed production such as broodstock culture, stimulation of maturation and spawning, egg fertilization, and rearing of fish larva, in practical training programs so that they can demonstrate and teach those techniques to core farmers.

Hormone injection is a basic skill to promote egg development and spawning of broodstock. (Teok Vil Center, Seim Reap)

Egg stripping is also a basic skill to collect matured eggs from broodstock. (Teok Vil Center, Seim Reap)

b) Grow-out Culture Technique

Extension officers must acquire the standard skills of fish grow-out culture, such as pond preparation, feeding management, and control of water quality and fish health.

The FAIEX project promoted cooking home-made feed for fish culture with local ingredients, such as rice bran, broken rice, vegetable, and local weeds.

Based on advice from extension officers, many farmers feed fish with termite nests. (Pursat)

Manure pits make liquid fertilizers for fish ponds to grow natural feed (plankton) economically and effectively using local ingredients.

Protection nets around fish ponds prevent predators of cultured fish such as snakeheads and frogs from entering the ponds.

c) Rice Cum Fish Culture Technique

Rice cum fish culture is also an important style of fish culture in Cambodia. Local farmers can use their paddy fields for rice farming and fish culture. They can harvest both crops at the same time and need no pesticide to kill insects because fish feed on them in paddy fields. Moreover, rice grows faster with farming fish.

In rice-fish culture, farmers grow rice with farming fish in the same place. Farmers do not need pesticide for rice farming because fish feed on insects in paddy fields.

Farmers harvest rice and fish at the same time in paddy fields.

d) Designing Fish Ponds and Hatcheries

Extension officers must advise fish farmers on proper fish pond and hatchery designs that suit land size and environmental conditions such as soil quality and water sources.

It is important to measure the land for proper advice on the design of a fish pond.

Fish ponds and hatcheries must be designed through discussions with local farmers.

5-4-2. Methods of Field Survey

a) Practical Interview Method

To identify important issues in small-scale aquaculture extension effectively, extension officers should collect relevant information regularly through interviews with and workshops with fish farmers. A semi-structured interview is a practical means to collect necessary information in a casual talk with fish farmers.

Semi-structured interview

A semi-structured interview is a practical way to find unexpected and hidden information smoothly by listening to what an interviewee has to say with a simple interview sheet. In such interview, extension officers need no complete questionnaire sheet. Prior to a field survey, an officer makes a simple interview sheet with only necessary items and questions. When visiting local farmers, the officer talks to them based on the sheet. Based on the farmers' answers, the officer will change or add questions. The officer draws occasionally a picture or chart on a piece of paper or notebook to derive clear answers from farmers in a visual way. The officer also listens closely to farmers to identify the real issues of their livelihoods.

Sample Interview Sheet

Interview Sheet	
Main topics:	
Sub-topic 1	Question 1-1
	Question 1-2
Sub-topic 2	Question 2-1
	Question 2-2

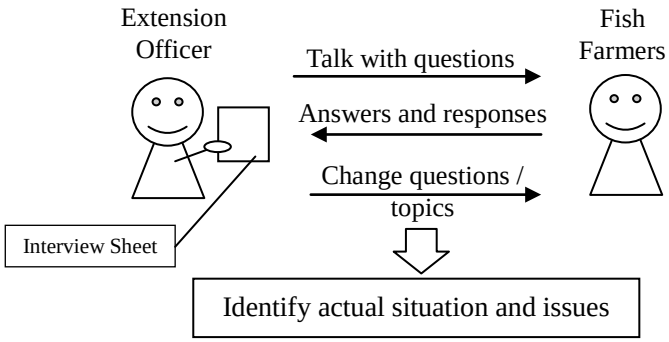


Figure 5: Image of Semi-Structured Interview with Fish Farmers

Extension officers visit fish farmers often to monitor the status of fish culture activities through interviews.

An interview with fish farmers should be done in a relaxing atmosphere to gain their honest views.

b) Geographic Data Collection and Analysis

The use of a Geographic Information System (GIS) is becoming common for arranging geographic position data and socio-economic information. Therefore, knowledge and skills on GIS help improve the data collection and analysis skills of extension officers. The officers should learn how to use GPS devices and software for extension activities and arranging information of target fish farmers.

Extension officers learn to use a portable GPS device to improve their field activities

5-3-3. Program Planning Method

.

Project Cycle Management (PCM) is a common method to formulate the operational plan of a project in a participatory workshop with stakeholders. PCM can be used to plan, monitor, and evaluate a development project. Problem analysis is a particularly effective tool to identify and discuss the general structure of issues in aquaculture extension in a participatory manner.

Problem Analysis

To consider proper measures to address the current issues in aquaculture extension, it is important to arrange the issues identified by interviews with fish farmers and observations of fish farms and hatcheries. A tree-type chart can be used to analyze the issues logically by a cause-and-effect relationship. Extension officers can find such relationship among the issues and develop it in a logical tree-type chart called a “problems tree.” A problems tree indicates the structure of the current issues clearly, and identifies effective measures to solve them.

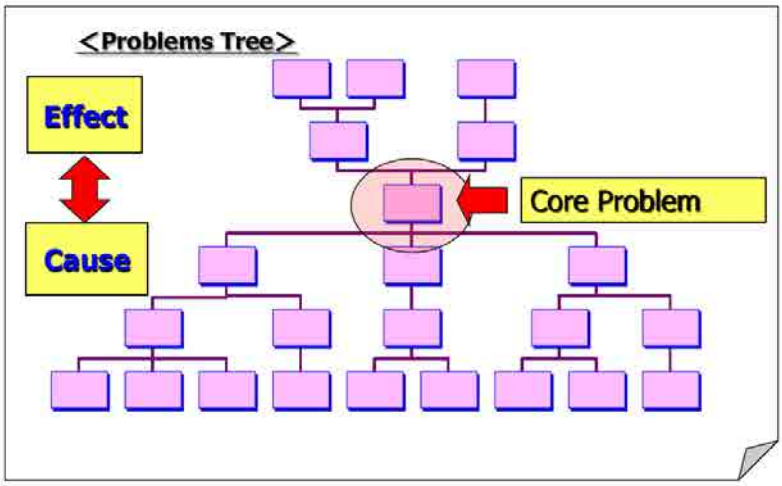


Figure 6: Image of Problems Tree

Extension officers of cantonment offices and officers of Aquaculture Development Department take part in PCM workshop at a Fisheries Administration Office.

Workshop participants analyze issues in aquaculture development in target areas by formulating a problems tree in the PCM method.

6. Future Visions of Aquaculture Extension

Based on the aquaculture development in other countries in Southeast Asia, the following future visions of freshwater aquaculture extension in Cambodia can be considered. To achieve those visions, the Fisheries Administration must form a long-term development plan in freshwater aquaculture.

6-1. Increasing the Capacity of Fish Seed Production

To promote fish culture production, it is essential to increase the capacity of fish seed production all around the country. At first, the facilities of government hatcheries for freshwater fish culture should be improved and expanded. It is ideal to establish at least one government hatchery per province to supply fish broodstock and seeds to local farmers. In addition, to ensure the supply of fish seeds to local farmers, it is important to increase private fish hatcheries and fish seed producers.

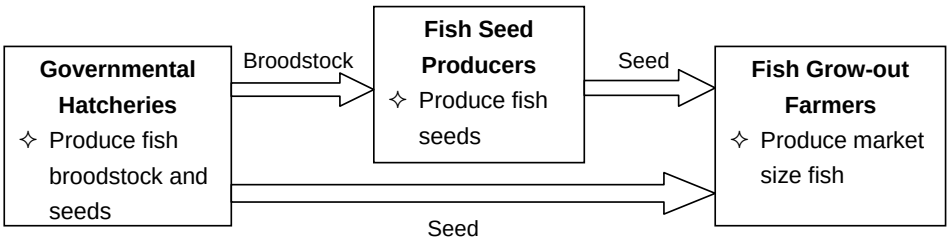


Figure 7: Model of Fish Seed Production Structure

Innovation of facilities at government hatcheries is necessary to improve the capacity of fish seed production. (Teok Vil Center, Siem Reap)

It is important to help local seed producers improve the capacity of fish seed production. (Battambang)

6-2. Improvement of Productivity of Freshwater Fish Culture

To improve the productivity of freshwater fish culture, the fish culture method should be changed from extensive culture to semi-intensive or intensive culture. To promote semi-intensive or intensive culture, the use of compounded feeds should be recommended to local fish farmers. Currently, compounded feeds distributed in Cambodia are imported from Thailand and Vietnam. Therefore, the Fisheries Administration should help local farmers make and distribute original compounded feeds from local materials for fish culture.

The promotion of fish cage culture is also important to improve the productivity of fish culture. Local fish farmers should switch their fish culture style gradually from earthen pond culture to cage culture in freshwater areas such as irrigation reservoirs or natural lakes.

Some local fish farmers have started culturing fish with commercial compounded feeds in semi-intensive style. (Battambang)

In Cambodia, fish cage culture in water reservoirs or lakes is rare. (Siem Reap)

6-3. Exploration of Cultured Fish Markets

While increasing the capacity and productivity of local fish culture, exploring proper markets of cultured fish should be also considered. It is necessary for local farmers to earn more cash income efficiently by fish culture production. The most important task for marketing cultured fish is to prepare and arrange proper distribution routes from fish farmers in rural areas to consumers in urban ones. Although the market demand for freshwater fish is very high, most fish farmers consume a large portion of their harvested fish in their families. If local distribution of cultured fish is well arranged, then local farmers will have more opportunities to sell cultured fish in local markets.

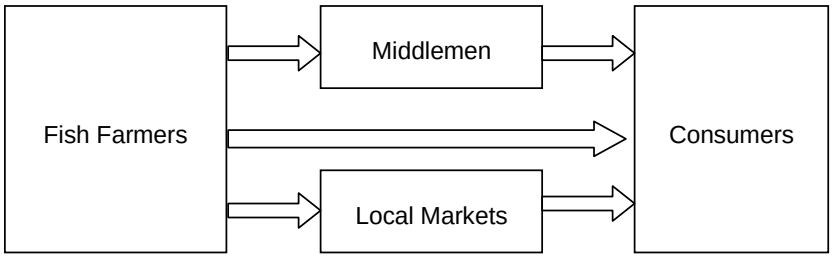


Figure 8: Distribution Routes of Harvested Fish from Farmers to Consumers

Most harvested fish are distributed by local middlemen or retailers. (Pursat)

Live fish can be transported and sold to local consumers. (Jambi, Indonesia)

6-4. Adding Value to Cultured Fish

At present, almost all cultured fish are distributed as fresh ones. However, it is difficult to preserve fresh fish for a long period at room temperature. In the future, fish farmers and distributors should consider processing excess fresh fish, or having such fish processed, into products such as smoked fish, boneless fish fillets, and bottled marinade fish. Those fish products can be preserved longer, and have an added value in markets. Moreover, the promotion of fish processing activities will encourage female farmers in rural areas to produce and sell processed fish products.

Salted dried fish is popular among local people as a preserved food in Cambodia. (Siem Reap)

Pangasius fish meat is usually processed into various value-added products such as fillet, sausage, and croquet. (Philippines)

ANNEX 6

(Final Report)

Community fish refuge guideline

Abbreviation Note:
RGC= Royal Government of Cambodia
FiA= Fisheries Administration
FiAC=Fisheries Administration Cantonment
CFR = Community Fish Refuge

Guideline on establishment and management of Community Fish Refuge

Introduction

Fish is one of people's crucial daily food items, including fresh fish and processed fisheries productssuch as fish paste, fish source, dried fish, fermented fish etc. are the most important for dailylife of over 14 million people in Cambodia. A finding study reported that fish is the most important source of animal protein for human consumption in Cambodia. It is estimated that in average, fish as a source of animal protein occupies 81.5 % of the totalanimal proteinintake of people of Cambodia and it is equivalent to around 52.4 kg/person/year. This figure is greater than 16 kg/person/year in average of the world. Currently, natural resources have been declining due to natural disaster such as drought, population growth, over fishing and illegal fishing operations such as poaching in dry season, over-catch of wild fingerlings, dynamite/cyanide fishing, as well as other destructive fishing such as fishing using small mesh size net, electro fishing, and other illegal fishing gears.

RGC takes immediate measures to tackle with the situations and prepares a policy for improvement of aquaculture development, a mean for rural households to encourage pond construction to grow-out fish and as asource of water for agricultural cropping and livestock under an advocacy of "one pond one family", as well as for realization of local fisheries resources management through CFR establishment in nation-wide in order to realize "**where there are water, where there are fish**" under a policy of "one commune one CFR".

At present, FiA of the Ministry of Agriculture, Forestry, and Fisheries has been promoting aquaculture development and fisheries resourcesmanagement in rural areas through implementation of training on fish culture and fish breeding for farmers. Those who havesmall-scale hatchery have been successfully operating their farm across the country. With regards to fisheries resources management in locality, establishment of CFR has been expanding from area to area. In order to make a package to disseminate these important activities, in terms of extension materials, FiA published a series of technical instruments, such as manuals on fish culture technologies, fish breeding technologies, and CFR-related documents, for the wide use of the whole country.

In contribution to realization of enrichment of fisheries resources in rural areas, FiA has published this guideline on "**Establishment and Management of CFR**" for all rural communities, local and competent authorities through competent fishery administrations and donors to improve knowledge and skills in line with this guideline.

Preface

This guideline on the “Establishment and Management of CFR” was made aiming capability and capacity improvement of extension-related staff of competent fisheries administrations or Non-Governmental Organization (NGO) as well as administrative officers of local authorities, and inspiration to all people concerns to be aware of successful operation of establishment and management of CFR.

Moreover, the guideline provides knowledge on protection and conservation of local fisheries resources. And the knowledge would be helpful to increase the fisheries resources in sustainable. This would provide incentives to rural poor households to have sufficient fish to eat and to walk along with the policy of RGC on poverty reduction.

Importantly, the guideline describes sequence of way on establishment and management of CFR for the convenience of extension-related staff to use and local community to understand. In addition, the guideline was compiled based on long-term working experiences of “CFR establishment and Management” in rural areas with successful case study which is currently being demonstrated to other communities. Common vocabularies are used in this guideline to make easy to understand for all level of audiences, especially for those who are supporting to agricultural extension activities.

In addition, this guideline will help facilitating research study and improve knowledge of students and researchers to deepen their discipline to modify and accelerate “CFR establishment and management”, which contributes to improvement of rural households’ livelihoods as well as enhancement of national economy.

Summary
on
The importance of guideline on establishmentand management of Community Fish Refuge

1. Benefit to Society
   - Building up awareness and knowledge on the importance of fisheries resources protection and conservation
   - Creation of good coordination among villagers, local authorities, and competent fisheries administration
   - Participation in fisheries resources protection
   - Expansion of activities on establishment of CFR from place to place
   - Sufficient fish supply for the people for their daily consumption and well-being
2. Benefit to Economy
   - Increase of fishery production of family-scale fishing and food supply for the population
   - Improvement of household income and living standard
   - Alleviation of poor rural households
3. Benefit to Environment
   - Enrichment of fish stocks in open access water bodies
   - Avoidance of extinction of endangered fish species
   - Maintaining well-balanced ecosystem

Contents:

APPENDIXS

Chapter I. Preparatory Step on Establishment of Community Fish Refuge

Appendix1. Detailed program of the two days' training workshop (as in article 3: Implementation of training workshop to support data and information collection derived from villagers and stakeholders)

Additional notification to appendix 1	data and information collection based PLA methods (as in article 3: Implementation of training workshop to support data and information collection derived from villagers and stakeholders)

Appendix 2. Detailed program of the two days' training workshop (as in article 4: Implementation of consultative meeting for verification of information collected, CFR Planning, and election for selection of CFRmanagementcommittee members)

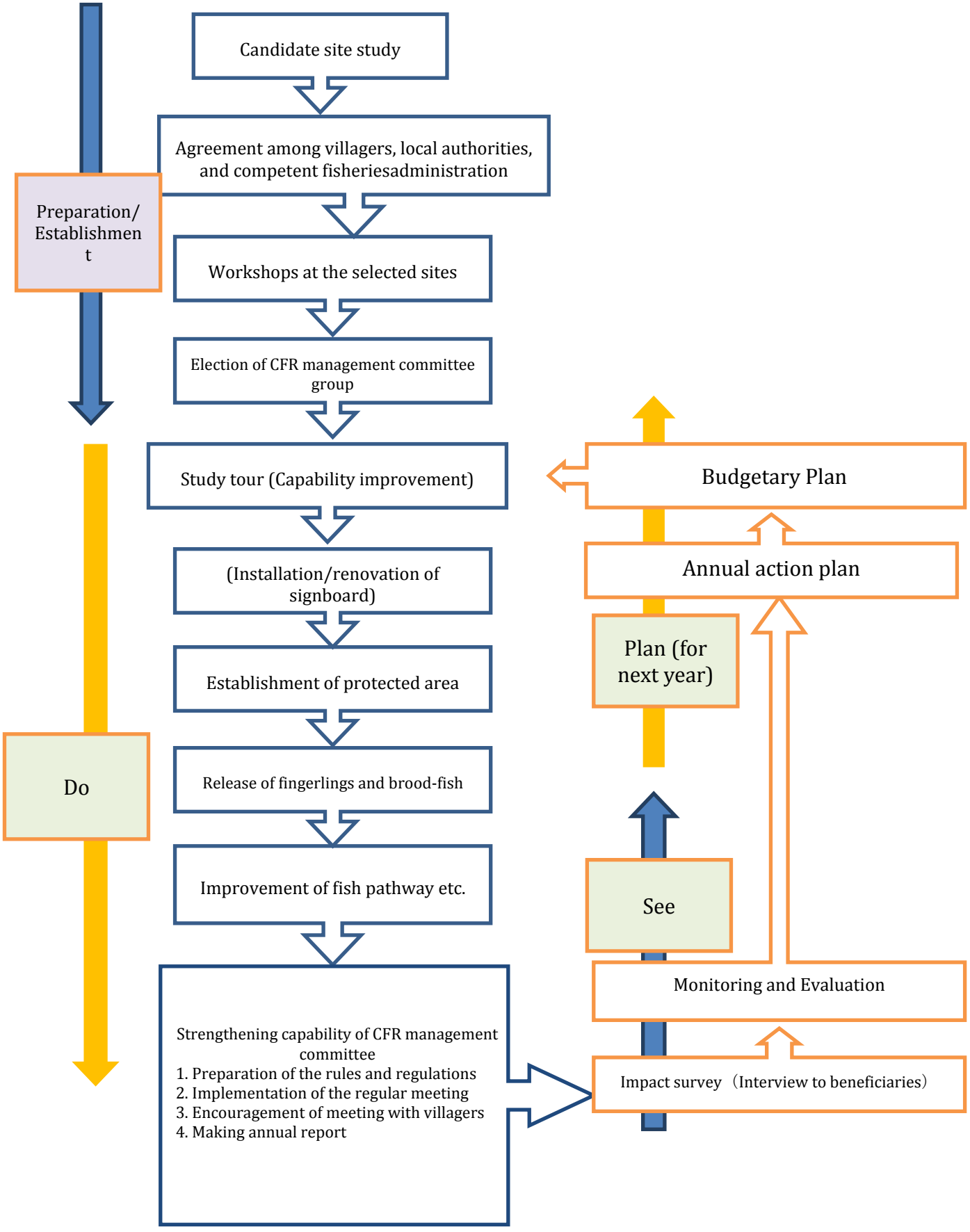
Additional notification to appendix 2	data and information collection based on PLA method (as in article 4: Implementation of consultative meeting for verification of information collected, CFR Planning, and election for selection of CFR managementcommittee members)

Chapter II. Management of Community Fish Refuge

Appendix 3.Questionnaires for the selected CFR management committee members (as in article 1: Preparatory step on study tour for the selected CFR management committee members

Appendix 4.Formulation of bye-laws and rules & regulations (as in article 6: Process of formulation of bye-laws and rules & regulations on CFR)

Flow chart of Establishment and Management of CFR



Charpter I

Establishement of Community Fish Refuge

Article1. Field Visit for CFR selection

1. Definition

What is "Fish Refuge Pond"?

Fish Refuge Pond is permanent water body considered as safe habitat for fish, ineither rainy or dry season, for their spawning, breeding, feeding and growing enabling to increase productivity/yield annually and allowing species diversification in natural water system, notably paddy field.

What is "CFR"- Community Fish Refuge?

CFR is common property "Public Water Body", under protection and management of group of people at the grass-roots society of which the people are living in identified administration territory.The group is officially recognized by village, commune, district and province level, as well as line government agencies, for instance, Fisheries Administration Cantonment (FiAC), and FiA, allowing **the group** has legal right to protect availability of brood-stocks of fish either in wet or dry season, as well as management task in monitoring on fishing operation of fishers in other water bodies, *so-called* "Open Access" connected to CFR.

CFR, generally, is established at existing suitable water bodies "natural ponds/reservoirs or man-made ponds", *so-called* common property, with good water condition "**year-round water**" located far from large water bodies, or associated water systems (tributaries/rivers). Good place for CFR is locations specifically surrounded by paddy field or flooded areas. Water bodies, common property, are considered as good habitat for CFR, such as small natural pond, lake, catchment, irrigated dike, reservoirs, man-made pond, and pagoda pond.

In article 1 "Process in selection of CFR" is indicated on selective identification of water bodies to establish CFR as a sack of reversing enrichment of fish in surrounded paddy field and/or flooded areas.This, in fact, contributes more incentives to farmers, remarkably poor household farmers are lack of ability to grow out fish, or don't have enough money for buying fish to take bettermeal for family. Points must be considered for the selection of CFRs are the following four (4) criteria;

i. Hydrological Aspect
   - Public water body or common property, such as small natural pond, lake, catchment, irrigated dike, reservoirs, man-made pond, and pagoda pond
   - Good water condition (at least one meter water depth in the dry season)

ii. Geographical and topographical aspect:
   - The pond is associated to paddies or flooded areas
   - Public water body or common property, as small natural pond, lake, catchment, irrigated dike, reservoir, man-made pond, and pagoda pond, located far from large water bodies, such as rivers, tributaries, lakes and irrigated channels which associated each other (See diagram below)
   - In the following sketch, pond 3 is the most prioritized geographical condition for selecting CFR establishment.

Diagram1…….

Main River and its system

Flooded areas

Refuge Pond

Irrigated channel

Priority Refuge Pond No. 1

iii. **Socio-economic aspect**

- Area with many poor population and depends only upon fisheries natural recourses as the common food commodity for their daily livelihood.
- Area identified as open access “both paddy field and flooded fishing ground ”
- Paddies, lakes, reservoirs, catchment, and trap pond with annual degradation in terms of yield and disappearance of some species.
- No conflict among villagers and/or villages related to the CFR

iv. **Management**

- Open access is usedby local villagers
- Strong support from local authorities, police and army, as well as support from villagers, elder people in the place or any famous villagers respected by local authorities.

2. Objectives (after establishing CFR)

- CFR works smoothly under good coordination and support of local authorities concerned.
- Established CFR is expected to become a model CFR with its replicable management mechanism for other CFRs

3. Expected outputs

- CFR is established in line with the above criteria correctly.
- Established CFR obtains sufficient cooperation and support of local authorities concerned.

4. Requirements

- Report on the criteria used for the CFR selection
- Map of the target CFR area to visit (if available)
- Sufficient number of competent fisheries administration officers with rich experience to go to the site selected

5. Implementation Activities

- The Criteria for the selection is well prepared and endorsed before planning to go to the field
- Competent fisheries administration officers understand clearly about the criteria for the CFR selection. Active discussion and collective preparation for the criteria done among task team beforehand.
- Site mapis prepared, if possible, for the implementation.
- A plan for the visit is clearly made.
- Good arrangement and appointment takenfor meeting/cooperation with villagers, especially fishers and local authorities. This is due to the fact that the active coordination, participation, and support from thepeople and authorities in line with the formulated criteria lead to effective dissemination, explanation and obtainment of knowledge.

- The task team[1] should visit some candidate sites as many as possible to focus the ideal sites. This provides task team to have more broad vision to evaluate good location for CFR establishment, as well as present the result to the stakeholder during the meeting with villagers and local authorities.
- The project manager[2] and task teamshall discuss on the result of the field visit of the task team. After the discussion the project manager together with the task team shall revisit to the studied sites for the final decision.
- The task team shall convert all the relevant data and information collected to electronic form using computer for the convenience in making reports and analyzing after the CFR established.This would be useful for compilation of CFR profile in the future.
- FiAC, responsible body, in supporting to right selection of CFR based on the criteria formulated, should friendly negotiate and cooperate with villagers, especially fishers, and local authorities who are the key informants allow the process of the CFR selection smoothly. This will shorten time of the work, and then overwork in the field can be minimized.

6. Main factors to be considered

- The process of CFR selection has to follow the endorsed criteria
- Field visit must be planned and conducted by informing beforehand and/or collaborating with villagers (fishers), and local authorities.
- In case of finding any unsolved matters, the task team needs to report to the project manager or expertized official (advisor) assigned by the project manager
- Sufficient number of visit to the candidate sites is needed.
- The task team must consist of highly qualified and responsible staff in CFR assignment

Figure
There are 3 pictures here with title as below

Prey Kuy CFR, Prey Veng province (Area: 0.15 ha)

Piry CFR, Kampong Speu province (Area: 1 ha)

TrapaingSamsib CFR, Kampot province (Area: 5 ha)

[1]Task Team organized by FiAC
[2]Director of FiAC

Article 2. CFR Agreement among Villagers, local authorities, and competent fisheries administration

1. Definition

Agreement shall be made between villagers and the relevant authorities to propose formal approval on establishment and management of CFR. Actually, village chief and commune head as representatives of the villagers and representatives of competent fisheries administration shall sign on the agreement. Before the signing, the relevant parties shall discuss on the issues about the CFR selected, inform stakeholders the objectives, methodology to get their understandings, and introduce successful findings of other sites to let them be aware, interested, and expectto have their CFR.

2. Objectives

- All the stakeholders fully understood and agreed to select the right CFR based on the criteria.

- Close coordination and cooperation between villagers and local authorities is built up.

3. Expected Outputs

- Consensus building is made among all levels of the stakeholders from the aspect of community management at the CFR selected.
- Villagers and local authorities fully understand and agreed on the process of establishment of CFR

4. Requirements

- Summary report on the findingsof the field study to presentinthe meeting.
- The summary report shall clarify;
  - Objectivesand method of site selection
  - Findings of the study (Map of theselected sites)
  - Annual action plan
  - Questions for discussion on the annual action plan

- Full set of handouts of materials, summary report on other model CFR and important deliveries, for presentation in the meeting
- Participant's list and recording notebook
- Meeting space can accommodate 50-60 participants with a stage for the chairman and delegates (Commune hall, school, pagoda etc., are recommendable.)
- 10 chairs and a table for chairman and delegates
- Chairs for 50-60 participants
- Microphone and echo-system for chairman and participants
- In case of unavailability of electricity power, the organizer needs to prepare the following some important equipment and facilities;
  - 3-4 kg of flipchart in quantity with A3 size
  - 6 sets of marker pen,white board pen with red, black and blue color
  - Summary report written on the flipchart
- In case electricity available in the meeting place,MS Power Point will be used for the presentation and summary report presentation, with some supportive devices like;
  - LCD projector
  - Screen
  - Eclectic extension and useful devices (cables, pointer etc.)

5. Implementation Activities

- The task team shall prepare detailed report on the findings of the field study for site selection of CFR, and then summarize to make handout for the participants
- The task team invites Sangkat/division of the Fisheries Administration, FiA, representatives of local authorities concerned to the meeting as its necessity of their supports;
  - The participants attend in fullone-day meeting
  - The organizer arranges a place for the meeting at some public spaces, such as commune hall, school, pagoda etc.
  - The task team asks local authorities to invite 50-60 important people such as village elders, laymen, fishers, competent authorities, in the meeting. It is recommended that some important/popular people who are respected by villagers, as well as considered by local authorities as "active people in helping development in the locality", to attend in the meeting.
  - The task team tries to invite people who used to make some illegal activities or practice improper fishing way in the meeting.
- People willing to establish CFR, shall make his/her address in the meeting agenda. Those people are;
  - Authority partner
    - Provincial governor, district governor, commune head, village chief
    - Leading people of the competent authorities
    - Villagers who have high intention in CFR establishment or people who has strong support from villagers and/or authorities.
  - Project Partner
    - Project manager as a representative of competent fisheries administration
    - Representatives of donor, if necessary
    - Task teamconsists of senior officials or advisors (resource person who will be able to lead the CFR successfully as the CFR's head reports good accomplishment under his/her mandate in the meeting.)

- A minute taker records comments and recommendations given in the meeting. The participants'list is necessary to keep and attach to the meeting record. This could be a proof of agreement about the CFR establishment between villagers and authorities.

6. Mainfactors to be considered

- During the meeting;
  - District governor, commune head,village chief or competent authorities should participate in.
  - Fishers involving in illegal fishing operation should be invited in the meeting.
  - People who have comprehensive talk/concept, and/or those who always do a good thing, and are loved/ respected by local villagers/authorities should participate in.
  - Participation of elderly villagers is indispensable.
- The task team must have a good coordination with villagers and authorities
- Presentation with missing/improper information should not be delivered.
- Poor explanation of speaker should be avoidedduring his/her presentation.

Pictures (4 picture)

Article 3. Implementation of workshop to support data and information collection from villagers and stakeholders

1. Definition

This step requires participation of similar attendants who were invited to join in the event of CFR establishment process. Such consultative workshop inviting participants, is a process of capacity building for local stakeholders on some PRA tools. The workshop enables them to make village profiles describe information on history of the CFR, fishing activities, consumption of fisheries product, use of CFR water resources, and socio-economic aspect in the each regime, etc.

2. Objectives

- Villagers and local authorities contribute to collect information on fishery resources appeared from CFR
- Information on benefit of use of CFR and problems in the past is identified.
- Villagers and local authorities can analyze information collected to support the process of CFR development plan

3. Expected Outputs

- Accurate detailed information on village and CFR collected.
- The information collected properly can be analyzed and used for adequate CFR development plan
- Villagers and local authorities initiate to consider about importance of the establishment of CFR and to involve more deeply in all the process.

4. Requirements

- Two days'meeting "Analyzing process" (as in appendix 1)
- TOR of facilitators consist of 4-5 people listed in the schedule/agenda
- Well prepared hand out on the each of presentation title in agenda for the participants, as well as for use in group discussion
- Availability of information for analysis (as in appendix 1)
  - 1. Administrative map, village and CFR location plotted in the map
  - 2. Number of public water bodies in the village (dimension, existing villageresources, and suggestion)
  - 3. Trend of annual catch
  - 4. Seasonal calendar
  - 5.Living standard (livelihoods) of the villagers
  - 6. Fish species caught
    - classification of fish species caught
    - basis of classification of fish caught
  - 7. Fish species consumed
    - classification of popular fish species for consumption
    - basis of classification of popular eating fish
  - 8.Information on history of the CFR in each regime (year event and impact)
  - 9. Village resources analysis and special support to fisheries development
  - 10. livelihoods options
    - Ranking of livelihood
    - Basis of the livelihoods options
  - 11. Village problem analysis
  - 12. Problem analysis in fisheries
- List of participants and notebook for the minute taking
- Meeting space can accommodate 50-60 participants with a stage for the chairman and delegates
- 10 chairsand a table for chairman and delegates
- Chairs for 50-60 participants
- Microphone and echo-system for chairman and participants

- In case of unavailability of electricity power, the organizer needs to prepare the following some important equipment and facilities;
    - 3-4 kg of flipchart in quantity with A3 size
    - 12 marker pens with red, black and blue color for writing on flipcharts
    - 1 white board of 2 meters in length and 1 meter in width
    - 6 marker pens with red and black color for writing on white board
    - Summary report written on the flipcharts
- In case electricity available in the meeting place, MS Power Point will be used for the presentation and summary report presentation, with some supportive devices like;
    - LCD projector
    - Screen
    - Eclectic extension and useful devices (cables, pointer or stick for showing report in the each presentation slide

5. Implementation Activities

- The task team shall prepare the following sheets for the 2-days' meeting agenda to collect information from villagers;
    - Format table for recording
    - Objectives on information collection
    - Methodology of information collection
- The task team shall train the facilitation team to teach how to manage responsible role of the each member and function sharing the 2-days' meeting agenda.
- The task team invites Sagkat/division of the Fishery Administration, FiA, representatives of local authorities such as village chief, commune head, and district/provincial government officials to the meeting as its necessity of their supports;
    - The participants attend in full two days' meeting.
    - The organizer arranges a place for the meeting at some public spaces such as commune hall, school, pagoda etc.
    - The task team asks local authorities to invite 50-60 important people, such as village elders, laymen, fishers, other competent authorities, in the meeting. It is recommended that some important/popular people who are respected by villagers, as well as considered by local authorities as "active people in helping development in the locality", to attend in the meeting., and
    - The task team tries to invite people who used to make some illegal activities or practice improper fishing methods in the meeting.
- People willing to establish CFR, shall provide his/her address in the meeting agenda. Those people are;
    - Authority partner
        - Provincial governor, district governor, commune head, village chief
        - Leading people of the other competent authorities
        - Villagers who have high intention in CFR establishment or people who has strong support from villagers and/or authorities.
    - Project Partner
        - Project manageras representative of competent fisheries administration
        - Representatives of donor, if necessary
        - Task team consists of senior officials or advisors (resource persons-who will be able to lead the CFR successfully as the CFR's head reports good accomplishment under his/her mandate in the meeting.)

- A minute taker records comments and recommendations made in the meeting. The participants' list is necessary to keep and attach to the meeting record. This could be a proof of agreement about the CFR establishment between villagers and local authorities.

6. Precautionary Factors

- During the meeting;
  - District governor, commune head, village chief or other competent authorities should attend.
  - Fishers involving in illegal fishing operation should be invited in the meeting.
  - People who have comprehensive talk/concept, and/or those who always do a good thing, and are loved/ respected by local villagers/authorities should attend.
  - Participation of elderly villagers is indispensable.
- The task team must have agood coordination with villagers and local authorities.
- Presentation with missing/improper information should not be delivered.
- Poor explanation of speaker should be avoided during his/her presentation.

Article 4. Implementation of consultative meeting on verification of the information collected, CFR Planning, and election for selection of CFR management committee members

1. Definition

Presentation on verificationof the information collected, CFR planning process with villagers/stakeholders, and election of CFR management committee members, are the final step of the process of CFR establishment. This step needs involvement of the similar attendants as in the previous step's meeting. This would be an indispensable process in verifying each previous meeting results compiled and is useful input for making action plan as well as arranging election of CFR management committee members with agreement from important partners, villagers, and all level of the local authorities.

2. Objectives

- Villagers and local authorities verify relevant information collected fromconcerned stakeholders to formulate a proper plan
- Villagers and local authorities create action plan for implementation of CFR management
- Villagers and local authorities arrangeand discuss on election process for the selection of the CFR committee members.

3. Expected outputs

- Accurate information for official use is collected from the stakeholders
- Annual action plan endorsed by local authorities and competent fisheries administration is prepared.
- CFR management committee members are selected through democratic election process collectively arranged and approved by villagers and local authorities.

4. Requirements

- Two days'meeting agenda (as in appendix 2)
- TOR of facilitators consist of 4-5 people listed in the schedule/agenda
- Well-prepared handout on the each of the presentation title in agenda for the participants as well as for use in the group discussionto collect further information
- Information analyzed (as in appendix 2)
  - 1. presentation about the result compiled for information collection
  - 2. plan prepared
  - 3. knowledge gained through workshop
  - 4. Expectation of villagers from the project
  - 5. Expectation of villagers from local authorities
  - 6. Expected support of villagers in fisheries development
  - 7. Suggestion from villagers
  - 8. Preparation of election event for selection of CFR management committee members (i.e; Odd number in minimum 5 and in maximum 11 must be elected from some nominated candidates. A chief, two chiefs, an accountant, members of CFR management committee must be appointed.)
- Participants' list and notebook for the minute taking
- Larger space can accommodate 50-60 participants including delegates
- 10 chairs and a table for chairman and delegates
- Chairs for 50-60 participants
- Microphone and echo-system for chairman and participants
- In case of unavailability of electricity power, the organizer needs to prepare the following some important equipment and facilities;
  - 2-3 kg of flipchart in quantity with A3 size
  - 12 marker pens with red, black and blue color for writing on flipcharts
  - 1 white board of 2 meters in length and 1 meter in width
  - 6 marker pens with red and black color for writing on white board
  - Voting papers for ticking and selecting CFR committee members

- Summary report written on the flipcharts

- In case electricity available in the meeting place, MS Power Point will be used for the presentation and summary report presentation with some supportive devices like;
  - LCD projector
  - Screen or white clothes
  - Eclectic extension and useful devices (cables etc.,)

5. Implementation Activities

- The task team shall prepare the following sheets for the one-day meeting agenda to collect information from villagers. Table sheet describes aims and methodologies for information collection within one-day meeting.
- The task team trains facilitation team to teach how to manage responsible role of the each member and function sharing the one-day meeting agenda.
- The task team invitescompetent fisheries administration and local authorities to the meeting, as its necessity of their supports;
  - The participants attend in full one-day meeting.
  - The organizer arranges a place for the meeting at some public spaces such as commune hall, school, pagoda etc.
  - The task team asks local authorities to invite 50-60 important people, such as village elders, laymen, fishers, competent authorities, in the meeting. It is recommended that some important /popular people who are respected by villagers, as well as considered by local authorities as “active people in helping development in the locality”, to attend the meeting.
  - The task team tries to invite people who used to make some illegal activities or practice improper fishing methodsin the meeting.
- People willing to establish CFR, shall provide his/her address in the meeting agenda. Those people are;
- **Authority partner**
  - Provincial governor, district governor, commune head, village chief
  - Leading people of other competent authorities
  - Villagers who have high intention in CFR establishment or people who have strong support from villagers and/or local authorities.
  - Project Partner
  - Project manager as a representative of competent fisheries administration
  - Representatives of donor, if necessary
  - Task team consists of senior officials or advisors (resource person who will be able to lead the CFR successfully as the CFR’s head and to report good accomplishment under his/her mandate in the meeting.)

- A minute taker records comments and recommendations made in the meeting. The participants’ list is necessary to keep and attach to the meeting record. This could be a proof of agreement about the CFR establishment between villagers and local authoritiesas well as entire endorsement in information collection from villagers to establish and manage CFR.

6. **Mainfactors to be considered**

- During the meeting;
  - District governor, commune head,villagechief or other competent authorities should attend.
  - Fishers involving in illegal fishing operation should be invited in the meeting.
  - People who have comprehensive talk/concept, and/or those who always do a good thing, and are loved/ respected by local villagers/local authorities should attend.
  - Participation of elderly villagers is indispensable.

- The task team must have a good coordination with villagers and authorities.
- Presentation with missing/improper information should not be delivered.
- Poor explanation of speaker should be avoided during his/her presentation.

4 images here

Charpter II

Community Fish Refuge Management

Article 1. Preparation of study tour for selected CFR management committee members

1. Definition

A studytour for new CFR committee members should be arranged after the committee members officially selected through democratic election process. CFR Management Committee iscomposed of chief, two vice-chiefs, committee members, and local authorities.All the members expected to join the study tour within capacity and capability of the project. The tour provides a chance for committee members to learn lessons and experiences in CFR management from other CFR committee members who have successfully been implementing and managing CFR.

2. Objectives

- New CFR committee members know and understand experiences of CFR management.
- The CFR committee members' awareness on proper management becomes high.
- The committee members of the some CFRs in different localities exchange views and opinions and collaborated each other for the better management.

3. Expected outputs

- New CFR committee members obtain knowledge in CFR management
- The committee members gainself-confident in managing CFR successfully.
- The committee members makes a good CFR management plan after returning from the tour

4. Requirements

- Questionnaires for new CFR committeemembers
  - for asking knowhow for the successful implementation done by model CFR (as in appendix3)
- Participants' list and notebook for the minute taking
- Transportation mean for the new CFR committee members

5. Implementation Activities

- The task team communicates with relevant authorities and CFR committee where the participants visit and asks their permission.
- The task team and the new CFR committee members discuss about objectives of the tour and questionnaire used for the interview to the model CFR committee before the new committee members visit.
- The new CFR committee members make the questionnaire mentioned above.
- The task team prepares one-day schedule for the study tour
- The task team arranges a meeting with the new CFR committee members after the members finished the study tour.This is to;
  - collect answers of the questionnaire
  - summarize knowledge and experience on how the model CFR committee successfully manage
  - modify the annual action plan for the new CFR

6. **Main Factors to be considered**

- All of invited management committee members of new CFR should participate in the tour.
- Sufficient communication must be taken for arrangement of the meeting between the new CFR committee members and model CFR management committee members.
- A questionnaire should be prepared by the new CFR management committee members

2 Pictures: showing study visit activities

Article 2. Installation of sign board for CFR

1. Definition

After completion of the study tour for the new CFR committee members,the task team prepares and installs 2 or 3 signboards in the main accessible pathway to indicate CFR management area and control any fishing activities of both local villagers and outsiders who have not known yet about the establishment of the new CFR. The task team shall discuss with the CFR committee members about the signboard model (as shown in the following figure), and decide it.

2. Objectives

- Stakeholders are aware of importance of installation of signboard for CFR.

3. Expected outputs

- The meaning of CFR clarified and shared among stakeholders after the discussion before the installation of signboard.
- The signboard constructed in proper location based on the result of the discussion.
- CFR committee members participate in the discussion and installation of the signboards.

4.Requirements

- Preparation for signboard construction is as follows;
  - List of equipment and facilities required (Annex □)
  - Model of signboard (as shown in the following picture)
  - Mold of signboard (as shown in the following picture)

- Participants' list and notebook for the minute taking

5. Implementation Activities

- The task team and the CFR committee members have meetings on the following points;
  - Meaning of signboard based on existing signboard's model
  - Number of signboard and location for the installation
  - Cost estimation for building signboard
  - Procurement place for buying the materials
  - Number of CFR committee members involving in signboard installation
  - Time/schedule for signboard construction
- The task team leads CFR committee members to build the signboard based on the model as shown in the following picture.

Picture of signboard model

6. **Main Factors to be considered**

- Materials' list meets technical requirement must be prepared.
- All the CFR committee members' attendance is indispensable in the discussion for preparation and installation of the signboard.
- In order to avoid short life of the signboard, proper method meets technical standard for the construction must be introduced.

Article 3. Preparatory step for establishment of protectedarea

1. Definition

Protectedarea is a part of or whole pond area of CFR to prohibit year-round fishing and to protect brood fish for the next spawning and breeding season. The CFR committee determines the protected area in cooperation and facilitation with the task team and local authorities in terms of involvement in technical advice and support to the protected area together. The protected area is generally established in the deepest area of CFR with large area either in dry or wet season when the location of the CFR separated into some area as open access for villagers to enjoy fishing.

2. Objectives

- The CFR management committee establishes a protectedarea to prohibit year-round fishing in the said area.
- The CFR management committee members voluntarily participate in and highly responsiblefor deciding protected area and actively involved in CFR management.
- Villagers are given open access for fishing even in the CFR, if the CFR has large area and if they engage in fisheries resources management, but not allowed to fish in the protected area.

3. Expected outputs

- The protected area is decided through discussion and approval among CFR management committee members and villagers.
- Signboard for the protected area is built in the CFR, and the protected area is managed by the CFR management committee members and villagers.
- Villagers and other stakeholders satisfy with establishment of the protected area because they still can fish in the CFR except for the protected area and also enjoy with legal fishing in both wet and dry season in surrounding area of the CFR.

4. Requirements

- CFR layout map
- Signboard model for building in the protected area
- Following materials for making CFR layout map and signboard model for recognition of the protectedarea.
  1) 10 papers with A3 size
  2) Adoze of marker pen with multi-colors
  3) Eraser
  4) Ruler
  5) Others
- Participants' list and notebook for the minute taking

5. **Implementation Activities**

- The task team and CFR management committee members prepare materials such as 10 sheets of paper with A3 size, a doze of marker pen with multi-colors, eraser, ruler, etc.,for making signboard for the protectedarea, and drawing a layout map of CFR.
- The task team arranges a meeting with CFR management committee members to discuss on;
  - Purpose of establishment of the protected area
  - Layout map of CFR
  - Determination of the protected area onthe layout map of CFR (The protected area must be confined to area where would not be dried up in the dry season)
  - Signboard model built in the protected area and it describes the area and the meaning
- CFR management committee arranges a meeting to disseminate information to villagers, especially fishers on the establishment of the protected area in the CFR. This is to share incentives in the whole community without affecting to villagers who are fishing in CFR or surrounding area of the CFR either in dry or wet season.

- CFR management committee places a remarkable signboard for the protected area of CFR.

There has picture here

6. **Main Factors to be considered**

- Representatives of local authorities and competent authorities should attend the meeting.
- Fishers involving in illegal fishing operation should be invited in the meeting as much as possible.
- People who hasconstructive opinions as opinion leaders and are respected by villagers/authorities should attend.
- Elder villagersshould also attend.
- Good coordinationamongst task team,villagers and local authorities should be taken.

Article 4. Stocking indigenous brood fish and fish seeds

1. Definition

This is usually done in an event for stocking indigenous species, especially rare/endangered species to support increase of those species as fisheries resources. This article, advisedly, emphasizes on the prohibition of release of exotic/alien species, such as Tilapiaand other carp specieswhich may bringnegative impact to fisheries resources, habitat, and ecosystem. In principle, the technical guideline mentioned that the species for stock enhancement should be indigenous species such as snakehead (*channastratia*), clarias sp., climbing perch (*Anabas testudineus*), Bronze feather back (*Notopterusnotopterus*), snake skin gourami (*Trigogasterpectoralis*), Trey Ta Oan (*Ompokhypophtalmus*), Trey Riel (*Henicorhynchussiamensis*), Spiny/Peacock ell (*Macrognathussiamensis*), etc., They are expected to adapt to environmental condition of CFR for their spawning and breeding and help to enrich diversity of fisheries resources in the paddy field and other floodplains, as well as to provide benefits to villagers, notably rural households in their daily fish consumption.

2. Objectives

- Fish catch increased and indigenous fish species diversified in CFR and paddy field and floodplains in the surrounding area of both large and small scale CFR.

3. Expected outputs

- Both fish catch and diversity of fish species, especially brood fish enriched in CFR
- Fisheries resources increased either in CFR or in paddy and floodplains, surrounding area of CFR.

4. Requirements

- Indigenous/wild brood fish for stocking in the releasing ceremony (Amount of fish is based on capability of supporter.)
- Wild fingerlings for stocking in the releasing ceremony. Those species are silver barb, snake skin gourami, climbing perch, Bronze feather back, *so-called* in Khmer Trey Chlat (The number of fingerlings are based on capability of supporters)
- Plastic bag, rice bag, rubber band, oxygen, for keeping fingerlings’life
- An aquarium tank for ceremony purpose, two scoop nets,
- Iron container with cover for transporting brood fish and means of the transportation

- Hall for releasing ceremony
- Participants' list and notebook for the minute taking

Main indigenous fish species for socking in the releasing ceremony

snakehead		Clarias		Climbing perch	
Silver barb		Snake skin gourami		Spiny/ Peacock ell	
Bronze feather back		*Henicorhynchus siamensis*		Butter catfish	

5. **Implementation Activities**

- CFR management committee arranges fish releasing ceremony and invites relevant person from competent fisheries administration, local authorities (village, commune, and district), competent authorities (police and army), fishers, and villagers to attend the event.
- CFR management committee holds a meeting with competent fisheries administration to discuss on the following points;
  - Fish species, number of brood fish and fish seeds of indigenous species proposed to stock/release
  - Leading resources persons[3], and total number of participants for releasing ceremony
  - Preparation of invitation letter for participants attend to the ceremony
  - Time/schedule of the ceremony
  - Location of scene for fish releasing
- CFR management committee takes measures for pre-arrange of brood fish and fingerlings in order to keep fish healthy and adjusts amount of fish to fit the approved amount as discussed in the meeting.
- CFR management committee prepares hall for the ceremony based on technical standard and capacity can accommodate the number of attendants.
- Fish release must be done before 10 AM because air temperature rises after 10 AM and this may cause some negative damages such as weakness and death of fish in plastic bags.

6. **Main Factors to be considered**

- Fish release after 10 AM must be avoided because of the above reasons.
- In order to keep health condition of brood fish and fingerlings good, poor collection of both brood fish and fingerlings, improper keeping fish in hapa or pond, improper packing fish into plastic bags, and poor transportation arrangement/mean must be avoided.

Article 5. Preparatory step for improving/renovating existing CFR system

1. Definition

This step means improvement and/or renovation of fish pathway. Fish migrates to surrounding paddy fields or floodplains from CFR in rainy season for spawning and breeding. Fish pathway with good performance has sufficient width and 2-3 different channels as fish pathways connect to CFR based on the size of CFR and quantity of fish passes between CFR and paddy fields and also floodplains.

2. Objectives

[3]Leading resources person meansrepresentatives of FiA,/FiAC, local authorities, and donors in some cases.

- Fish can migrate from CFR to paddy field or floodplains and continue their spawning/breeding in the paddy field.
- Villagers have equivalent opportunity to catch fish easily.
- Fish can come back to CFR in dry season. Thus brood fish and fingerlings can be available and sustainable for the next spawning and breeding season.

3. Expected outputs

- In paddy fields and floodplains surrounding the CFR and associated channels, fish catch increased after a year brood fish and fingerlings released.
- Some brood fish migrated out during wet season returned to the CFR where they were released and living in dry season for the next spawning and breeding season.

4. Requirements

- Tools for digging (hoes, shovel, basket, etc.)
- Wooden stick
- Culvert with cement, sand, brick, gravel etc.

5. Implementation Activities

- The task team arranges a meeting with CFR management committee to discuss on the following points;
  - Number of associated channel and/or fish pathway to be constructed or improved
  - Width and length of associated channels or fish pathways that can be constructed or improved based on the dimension of CFR
  - Depth, dimension and height of dike of CFR in case of the improvement
  - Number of labor
  - Date of commencement and ending of the engineering work
- Associated channels and/or fish pathways should be constructed in lower position to make water flow easy between CFR and paddy fields in rainy season.

Spawning/breeding characteristics and fish movement inCFR

1- Early rainy season:

Rain startsfrom early May.

Brood fish starts to spawn and breed in CFR.

2- Precipitation increases in August

Both brood fish and fingerlings start to move from CFR to flooded paddy fields through associated channels and/or fish pathways

3- Paddy fields and floodplains are totally filled by water from September to November. Brood fish continue to spawn and breed, while fingerlings grown and distributed in the paddy fields and floodplains.

4- Water starts to recede from November.

Fish migrate from shallow place to deeper place and CFR.

5- Dry season
Dry season from December to May.
In dry season, fish stays in CFR.

6. **Main Factors to be considered**

- If the associated channels and/or fish pathway are too small, it seems difficult for fish to move into CFR and out from CFR.
- If the associated channels and/or fish pathways are too large, it seems that number of fish moves out of CFR is much more than that of remain in the CFR.

Article 6. Process of formulation of rules and regulations on CFR management

1. Definition

This step means a process of making rules and regulation for CFR management which requires active participation in the discussion and approval among each of stakeholders such as fishers, local authorities, competent authorities, and fisheries administration. This active participation among stakeholders is indispensable to manage CFR effectively and required by the government policy in promoting one CFR in one commune. The formulation of rules and regulations are recognized by the competent and local authorities aiming at sustaining utilization of fishery resources of community in line with the said rules and regulations as well as increasing fish catch annually in sustainable manner.

2. Objectives

- Fisheries Administration and local/competent authorities officially recognize and endorse the rules and regulations formulated.
- All the important cases are introduced in the rules and regulations through discussion.
- Stakeholders officially recognize and practice the rules and regulations formulated.

3. Expected outputs

- CFR officially recognized by competent fisheries administration[4] and local authorities after the establishment.
- All stakeholders follow the rules and regulationsand actively participate in effective management of fisheries resources
- CFR is managed adequately.

4. Requirements

- Draft of rules and regulations for meeting with villagers and authorities (as in appendix 4)
- Participants' list and notebook for the minute taking
- In case of unavailability of electricity power, the organizer needs to prepare the following some important equipment and facilities;
    - 2-3 kg of flipchart in quantity with A3 size
    - 12 marker pens with red, black and blue color for writing on flipcharts
    - 1 white board of 2 meters in length and 1 meter inwidth
    - 6 marker pens with red and black color for writing on white board
    - Voting papers for ticking and selecting CFR committee members
    - Summary report written on the flipchart
- In case electricity available in the meeting place, MS Power Point will be used for the presentation and summary report presentation with some supportive devices like;
    - LCD projector
    - Screen or white clothes
    - Electric extension and useful devices (cables etc.,)
    - Light pointer or stick used for the presentation

[4] FiA and/or FiAC

5. Implementation Activities

- The task team invites competent fisheries administration, representatives of local authorities to the meeting, asits necessity of their supports;
  - The participants attend in full one day meeting.
  - The organizer arranges a place for the meeting at some public spaces such as commune hall, school, pagoda etc.
  - The task team asks local authorities to invite 50-60 important people, such as village elders, laymen, fishers, competent authorities, in the meeting. It is recommended that some important/ popular people who are respected by villagers, as well as considered by local authorities as "active people in helping development in the locality", to attend in the meeting.
  - The task team tries to invite people who used to make some illegal activities or practice improper fishing way in the meeting.
- People willing to establish CFR, shall provide his/her address in the meeting agenda. Those people are;
  - Authority partner
    - Provincial governor, district governor, commune head, village chief
    - Leading people of competent authorities
    - Villagers who have high intention in CFR establish mentor people who have strong support from villagers and/or authorities.
  - Project Partner
    - Project manager
    - Task teamconsists of senior officials or advisors (resource person who will be able to lead the CFR successfully as the CFR's head and to report good accomplishment under his/her mandate in the meeting.)
- A minute taker takes record of the meeting with comments and recommendations. The participants'list is necessary to keep and attach to the meeting record. This could be a proof of agreement about the formulation of rules and regulations between villagers and authorities for the proper management of CFR.

6. Main Factors to be considered

- During the meeting;
  - Representatives of local authorities and competent authorities should attend.
  - Fishers involving in illegal fishing operation should be invited in the meeting as much as possible.
  - People who have comprehensive talk/concept, and/or those who always do a good thing, and are loved/ respected by local villagers/authorities should attend.
  - Elder villagers should also attend.
- Good coordination between task team, villagers and authorities should be taken.

Article7. Preparation of CFR monthly meeting

1. Definition

Monthly meeting is an important activity for improvement and development of CFR committee members. All of CFR committee members consist of a chief, two vicechiefs, and other members, and also fishers, competent authorities, and local authorities need to participate in the meeting. The meeting is arranged in simple way and held at any convenient places such as house of CFR chief, house of village chief or commune head etc. Another option for the meeting place can be villager's house. The merit of this case is to make further close relationship between villagers and relevant authorities. This contributes to enhancement of voluntary participation of the stakeholders for better management of CFR.

2. Objectives

- The CFR management committee members take initiative to discuss on challenging issues identified, find ways for the solution, and report on the progress of monthly activities.
- Consciousness of CFR management committee members, villagers, local authorities and competent authorities is enhanced to participate in the activities for protection of fisheries resources in the CFR area by sharing lessons and experiences in the meeting.

3. Expected outputs

- Challenging issues identified and addressed with fine solution.
- Lessons and experiences in CFR management shared each other among stakeholders involved.
- Management of CFR becomes better and done effectively.

4. Requirements

- Handout materials for distributing to the participants
- Whiteboard and marker pen
- Participants' list and notebook for theminute taking
- Extension materials (if available as in the followingpicture)

There have 2 pictures here

5. Implementation Activities

- Chief of CFR management committee as a chairman and facilitator(s) prepare the meeting agenda and handout materials for the participants.
- The meeting agenda consists of the following elements;
  - Welcome address made by chairman
    - Acknowledgement
    - Achievement of the previous month
    - Challenging issues, and means for the solution
    - Plan for the coming month
  - Ideas shared by fishers and villagers' representatives
    - Reduction of illegal fishing by type of activities
    - Fish catch (species, quantity of catchper family/day)
    - Other issues identified
    - Suggestions
  - Remarks made by project facilitator
    - Evaluation on past accomplishment
    - Comments on how to settle main challenging issues and next plan of implementation
  - Remarks made by competent/local authority representatives
    - Reference of intervention about some difficult matters to settle
    - Enforcement of fisheries law and rules & regulations of CFR
    - Support for disseminating CFR establishment and the management to other villages and communes.
- The CFR management committee registers participants and taking important notes, as shown below, to be able to monitor and evaluate the activities of CFR management for the next meeting.
  - Findings from past experiences and lessons learned for future activities
  - Issues occurred newly and the measures for the solution
  - Good practices experienced (both achievements and ideas/comments)
  - Action plan for continuation of CFR management andimplementation

6. Main Factors to be considered

- During the meeting;
  - Representatives of local authorities and competent authorities should attend.

  - Fishers involving in illegal fishing operation should be invited in the meeting as much as possible.
  - People who have comprehensive talk/concept, and/or those who always do a good thing, and are loved/ respected by local villagers/authorities should attend.
  - Elder villagersshould also attend.
- Good coordinationamongCFR committee, villagers and authorities should be taken.

Article 8. Monitoring and evaluation

1. Definition

This activity shall be done to share understandings what extent of work accomplishment of CFR management and then evaluate to conclude comprehensively about CFR management. Monitoring and evaluation shall start after CFR established and the management activities started. Monitoring, in general, shall be conducted one year after CFR established. Some important indicators are examined, for example, "Whether fish catch increased in this year or notthrough verification in the field observation, questionnaire survey, report analysis and/or group discussion.

2. Objectives

- Relevant parties on CFR such as CFR committee members, FiAC, local authorities, villagers clearly know about achievement of the CFR management activities based on indicators and identify constraints to be solved to attain the goal.
- CFR committee members improve the implementation strategy and modify the plan for the coming year based on the results of monitoring and evaluation.

3. Expected outputs

- Crucial obstacles in the process of CFR management are clarified.
- The CFR management activities runsuccessfully.
- Measures to settle problems and difficulties are verified through the implementation.
- Strategy and plan for CFR management and implementation improved and this brings better results.

4. Requirements

- Questionnaires for fishers
- Items should be reflected in the report for project officers of competent fisheries administration
- Participants' list and notebook for theminute taking

5. Implementation Activities

- Questionnaires are prepared for interviewing fishershighlighting on the following important points;
  - Quantity of fish caughtby species (including water inhabitants such as paddy field crab, snail, frog, paddy field shrimp, etc.) and by type of fishing gears in both dry and wet season.
  - Type and size of fishing gear used in dry and wet season
  - Frequency and hours of fishing per day, week, month in both dry and wet season
  - Number of person involved in fishing in the family in both dry and wet season
  - Number of fishers and gears by type of fishing gear in the fishing ground for both dry and wet season
  - Accessibility to fishing ground in both dry and wet season
  - Area of fishing for operation in both dry and wet season
- Questionnaires are prepared for interviewing local authorities focusing on the following points;
  - Supporting policy of local authorities for CFR management
  - Activities of local authorities for the support and extension

- Species and size of fish that fishers caught
- Perception of villagers on the importance of CFR establishment and management
- Negative factors and means for the improvement
- Goals and plan for continuation of CFR implementation and management

- All the collected information, such as answers of fishers and local authorities in response to the questionnaires, report of project officers, as well as result of meeting with villagers, fishers and local authorities, should be typed out or input into computer.
- The achievement of CFR management targeting for the following points is examined and analyzed;

1. Seasonal catch assessment
2. Annual household catch assessment of paddy field fishing (kg/year/family)
3. Number of family engaging in paddy field fishing
4. Village caught assessment (ton/year/village)
5. Change of fish caught after CFR established
6. Economic benefit of CFR (US$/year/CFR)
7. Composition of fish[5] consumption

There have 4 diagrams showing here

Village	Household catch assessment of paddy field fishing (kg/year/family) (April 2006 - March 2007)			Number of family engaging in paddy field fishing		Village fish catch assessment (ton/year/village)		
	Wet	Dry	total	Wet season	dry season	wet season	Dry season	Total
Piry	300	60	360	94	35	28	2	30
Prey Kdouch	474	210	684	260	260	123	55	178
Damnak Troap Khang Choeung	101	17	117	198	74	20	1	21
Samroang	65	21	86	130	49	8	1	9

Result of economic analysis on "CFR management" in the sites of 2006 and 2007

No.	name	Province	Area of CFR in wet	Revenue ($USD)
1	Piry	Takeo	80 ha	35,500
2	Prey Kdouch	Kampong Speu	1 ha	11,900
3	Damnak TroapK hang Choeung	Kampot	5 ha	5,700
4	Samroang	Prey Veng	0.15 ha	2,300

[5] This includes any kind of edible water inhabitants such as water insects, turtles, frogs etc.

6. Main Factors to be considered

- Questionnaires prepared for fishers and local authorities should not be detailed and should cover relevant aspects used for analysis and evaluation.
- It is very important for the interviewers such as project officers etc., to fully understand the meaning of the questionnaires and how to ask questions to interviewees.
- All the interviewees such as villagers, fishers, offenders, elder people, competent and local authority etc., must be provided sufficient and clear information required.

CONCLUSION

All the above elaborated articles are avoidable essential lessons or any key title/sub-title in the each article and these also require extension-related staff to understand comprehensively about the meaning of the each article as well as title/sub-title therein. This would be good inputs in supporting process of CFR establishment and management, then resulting successful achievement of the operation. In overall, this guideline visibly clarifies how to proceed the operation smoothly and positively in terms of establishment and management of CFR. The following points must be taken into account;

- Both project officers and extension-related staff must be highly responsible for following all matters emphasized in the guideline and having an insight into situation promptly and timely, and solving issues properly through their self-observation. In case issues difficult to settle arisen, person in charge must report immediately to the project manager to take early intervention.
- Both project officers and extension-related staff need to have facilitation skill to work with all levels of people and local and competent authorities.
- This guideline clearly stresses that all activities on CFR establishment and management need participation of all levels of stakeholders, villagers and local and competent authorities.
- Both project officers and extension-related staff have to explain and disseminate concept of CFR to all relevant stakeholders to make their awareness higher for better management of fisheries resources in the locality aimingannual enrichment of fish yield. This could be achieved, if stakeholders join in the process of decision making, for example, formulation of annual action plan. And during the implementation of the plan, all the stakeholders are required to participate in important events and meetings to speak out their opinions/ideas on fisheries resources management.

APPENDIXES

Appendix1

Chapter 1. Establishment of Community Fish Refuge

(See Article 3 for the explanation: **"**Implementation of workshop to support data and information collection from villagers and stakeholders**")**

Program of 2 days'workshop

Day1

Time	Activities	Facilitator
08:00	Registration	Project Officer
08:00-09:00	Opening Session • Report of Communeand/or District • Objectives of the Project and workshop (presenter: project manager) • Opening speech (provincial governor)	
09:00-11:30	**Group Discussion**	Project Officers
	1. Drawing layout map of village and CFR 2. Figure of public water bodies in the village	
	3. Trend analysis on annual fish catch 4. Seasonal calendar	
	5. Level of households' livelihood 6. Fish species caught from wild stocks -Classification of fish caught - Basis for theclassification	
	7. Fish species for consumption - Ranking of popular fish species consumed - Reasonsfor the selection	
11:30-01:30	Lunchbreak	
01:30-03:30	Group presentation	CFR members
03:30-04:00	• Wrap up of the day 1 • Closing address of theday 1 agenda	Project Officer or Project Manager

Day 2

Time	activities	Facilitator
08:00	Registration	Project Officer
08:00-11:30	**Group Discussion**	Project Officer
	8. History of village and CFR 9. Resources Analysis	
	10. villagers' occupation - Ranking of livelihood options - Reasons of theranking	
	11. Problem analysis 12. Problem analysis on fisheries	
	Group presentation	CFR members
11:30-01:30	Lunch break	
01:30-03:30	Group presentation (continuation)	CFR members
03:30-04:00	• Wrap upof the workshop • Closing address of the workshop	Project Manager

Additional memo for Appendix1

1. Layout map of village and CFR

In order to support in laying out village and CFR on the map, cooperation of elder villagers such as village chief, and elder villagers, etc., who are familiar with village geographic aspects. In addition, locations of important landmarks as village resources that all villagers know well, need to be marked on large paper.The following map is an example of village layout and CFR map of Piry village, Piry Meanchey commune, Borset district, Kampong Speu province.

Piry Map here

2. Figure of Village'spublic water bodies (Example)

Name of water bodies	Area in wet season	Area in dry season	Inhabitants	Suggestions
Piry pond	Width: 110m; Length: 75m; Depth: 2m	Width: 45m; Length: 65m; Depth: 1m	- Clarias, snake head, ell, frog, snail, water lily, lotus, water hyacinth	- dike renovation - reforestation - villagers and authorities eliminate illegal fishing activities -fencing the CFR

3. Trend analysis on the annual fish catch

Fishers are required to assess their yearly catch of each public water body (open access) such as lake, natural pond, and reservoir etc., and this should be described as in the table below.

Name of water body	Year	Yield (kg)	Fish species	Fishing gear used

Here there has diagram of Prey Kdouch water system

4. Seasonal calendar

Economic activities of villagers in a year

Activities	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.

5. Living standard

Definition used for judging living standard of villagers must be discussed and decided initially. For instance, “better-off”, “moderate”, “poor”, “very poor” etc., are used in the questions to identify villagers’ living standard after the each criteria defined.

Then, participants of the workshop start to debate on living standard of each family in the village by writing family names in the table below and count the number of families classified into the each category.

Better-off = families	Moderate= families	Poor = families	Very poor = families
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

6. Wild fish species (Fish species caught from natural environment)

Classification of fish species caught from natural environment is made by using pair-wise ranking tool to compare fish availability and abundance. This tool requires farmer to evaluate two fish species for the comparison each other.

Water bodies	Season ofcatch		Yield (kg/family)	Species caught	Fishing gearsused
	Dry season	Wet Season			

6.1. Dominant fish caught from natural environment

Species	A	B	C	D	E	F	G
Score							
A	x						
B	x	x					
C	x	x	x				
D	x	x	x	x			
E	x	x	x	x	x		
F	x	x	x	x	x	x	
G	x	x	x	x	x	x	x

6.2. Reasons of dominance of fish species caught

1-A

2-B

3-D

4-G

7. Fish species consumed

This comparison also uses pair-wise ranking tool to evaluate relations between two species that villagers preferably consumed for the comparison.

7.1. Dominant fish consumed by villagers

Species	A	B	C	D	E	F	G
Score							
A	x						
B	x	x					
C	x	x	x				
D	x	x	x	x			
E	x	x	x	x	x		
F	x	x	x	x	x	x	
G	x	x	x	x	x	x	x

7.2. Reasons of dominance of fish species consumed

1-G

2-D

3-B

8. History of village and CFR (Description of year of establishment, regime, big event of disaster affected to the village etc.)

This taskshould start from olderregime's history and move to newer onesby mentioning what happened in the each regime.

Year	Regime /Disaster etc.	Historical facts
1975-1979	Pol Pot regime	-People lived in collective condition; they ate together and shared property for their organization -People worked beyond his/her capacity.They had insufficient food to eat. -People were skinny and had chronic disease, swollen limb and others -Family members livedseparately -No schools for children -It was not allowed to respect religion.
1987-1988	Drought	-Shortage of water -Low yield of rice production -Livestock diseases.
2003-2005	Drought	-Rice didn't grow and vegetable was spoiled -Shortage of water for human and livestock consumptioncaused disease -People faced difficulty of living condition -Fish and cropseed lost -people had diseases -Income sources of family lost.

9. Village resource analysis and resources support fishery sector

(All resources available in the villageshould be clarified.)

In order to get current information available in the village, participants shall clarify focusing on natural resource, human resources, social capital, economic input, and materials resources.

Natural resources	Human resources	Social capital	Economic input	Materials resources
- - -	- - -	- - -	- - -	- - -

10. Villagers'occupation

In order to use pair-wise rankingtool, the participantshave to list all occupations exist in the village and then identify dominant occupations in compare to two occupations.

10.1. Dominant occupation

Occupation	A	B	C	D	E
Score					
A	x				
B	x	x			
C	x	x	x		
D	x	x	x	x	
E	x	x	x	x	x

10.2. Reasons of dominance of occupation

1-E

2-D

3-B

4-A

11. Problem analysis (All issues happened in the village should be described.)

In problem analysis in the village, each group consists of the participants has to clarify problems farmer encountered, causes of the problems, effects and considerable solutions.

Encountered issues	Cause of problem	Effect	Approach	Solution
*-	- -	- -	- -	- -
*-	- -	- -	- -	- -
*-	- -	- -	- -	- -

12. Problem analysis on fisheries

Each group has to speak out about important relevant problems associated with fishery sector.

Encounteredissue	Cause of problem	Effect	Approach	Solution
*-	- -	- -	- -	- -
*-	- -	- -	- -	- -
*-	- -	- -	- -	- -

Appendix 2

Chapter 1. Preparation of Community Fish Refuge Establishment

(Article 4 “Implementation of consultative meeting on verification of the information collected, CFR Planning, and election for selection CFR committee members”)

Program of 2-day’s workshop

Day1

Time	activities	Facilitator
08:00	Registration	Project Officer
08:00-09:00	Opening Session • Report of Communeand/or district • Objectives of the Project and workshop (presenter: project manager) • Opening speech (provincial governor)	
09:00-11:30	1. Presentation onverification of information collected	Project Officer
11:30-01:30	Lunchbreak	
01:30-02:30	Group Discussion 2. Planning	Project Officer
02:30-03:30	Presentation of group discussion	Participants
03:30-04:00	• Wrap up of the day 1 • Closing address of the day 1 agenda	Project Officer/Project Manager

Day 2

Time	activities	Facilitator
08:00	Registration	Project Officer
08:00-10:30	Group Discussion 3. Information and knowledge obtained from workshop 4. Farmers’expectations 5. Relevant authorities’ expectations towards farmers 6. Farmers’ involvement in fisheries development support 7. Suggestions of villagers	Project Officer
10:30-11:30	Group presentation	
11:30-01:30	Lunchbreak	
01:30-03:00	8. Preparation of election for selection of committee members of CFR	Project Officer
03:00-03:30	• Wrap up of the workshop • Closing address of the workshop	Project Manager

Additional memofor Appendix 2

1. Presentation on verification of information collected

This is a time to present villagers and local authorities on all information that gathered by project officers from the first meeting. The presentation aims to get comment and verified idea from the stakeholders, and then this is a good input for planning process.

2. Planning process

Action plan is formulated through meeting and collectively endorsed by CFR committee together with villagers and all level of local authorities in order to have clear and effective action plan. The following is summary table about CFR action plan.

Activities	Time Schedule	Responsible person	Village resources	Shortage	Supporter

3. Information and knowledge gained for the workshop

This action is a good chance for villagers and authorities to have meeting each other to discuss on major issues in relation to the progress of fisheries resources in their locality, encountered matters, cause of problems, challenging, and seeking fine solution, etc., enabling to emerge an idea to establish and manage CFR, as well as their efficient involvement in the implementation.

4. Farmers'expectation from the Project

This is a step to collect information from villagers or communities about their needs towards the project for their self-benefit, as well as benefit of whole communities.

5. Farmers'expectation from local authorities

It is advantageous for farmers or communities, if local authorities participate and support implementation of CFR action plan in assisting protection of fisheries resources in the CFR effectively and sustainably.

6. Farmer's determination in fisheries development support

This is an action of collecting information on villagers/communities' consciousness about protection and conservation of fisheries resources in CFR aiming at annual increaseof fish yield.

7. Villagers' suggestion

This is an action of collecting information on various suggestions to be able to create CFR action plan to operate successfully in sustainable manner.

8. Preparation of election for selection of CFR management committee

In order to have a transparency in the process of selection of CFR management committee, candidates shall be nominated from the villagers in the meeting. After the candidate's listmade, democratic election process shall be taken among villagers and stakeholders to select a chief, two vice chiefs, and at least two more members in minimum or eight more members in maximum. The total number of the CFR management committee must be odd number. Finally, CFR management committee composed of five in minimum or eleven in maximum members to coordinate and manage fisheries resources in locality.

APPENDIX 3

Chapter II. Community Fish Refuge Management

(Additional clarification for article 1: "Preparatory step on study tour for selected CFR committee")

Questionnaires for new CFR management committee

1. Questionnaires for new CFR management committee on the CFR established

1. Are there any important factors for successful implementation of CFR management?
2. Are there difficulties or constraints in CFR management? How CFR management committee tackled with these issues, and are the solutions effective or not?
3. What are causes of those difficulties and constraints?
4. What kind of measures can be taken in order for villagers to more voluntarily participate in all the activities of CFR management?
5. How was fish caught in kg per family before CFR established, and how changed after the CFR establishment?

2. Questionnaire for individual CFR management committee

1. What are your lessons and experiences learned from establishment and management of CFR?
2. What are obstacles for CFR management? And what are your measures for the solution?
3. Do you think if all lessons and experiences learned from the study tour would be useful to manage CFR in your place? Please specify.

Crucial points for new CFR management committee to make observation

1. Location of CFR established (inside or outside of village/existence of villagers' house nearby etc.)
2. Dimension of CFR (ha) in wet and dry season
3. Fish pathway (locationand number)
4. Signboard for CFR (number of signboard and the location placed)

APPENDIX 4

Chapter 2. Community Fish Refuge Management

(Further reading in article 6: "Process of CFR by-law formulation")

Process of formulating by-law

KINGDOM OF CAMBODIA
NATION RELIGION KING

By-laws and Rules
of
Fish Refuge Pond (draft version)

This legislative document, *so-call* By-law and Rules on the management of Community Fish Refuge made in ……days, ……..village, …….commune, ……..district, …….province.

Article1. Name, Location and size

- Fish refuge pond entitles (.....)
- In abbreviated form is (.....)
- Office location: ……..village, …….commune, ……..district, …….province.
- Functioning CFR: Width……m, Length……m

Article2. Main Objectives of establishment of CFR

- Wild stocks of fish increased in ricefield, channel, and floodplains through brood-fish protection and adequate resources management in the dry season, *so-called* community pond or stocked-water pond, and then such system officially entitled "**Community Fish Refuge**"
- Fish catch increased in paddy and surrounding areas of CFR especially for poor and landless farmers. They enable to enjoy family-scale fishing for their daily household consumption.
- Food security of rural farmers improved, who live far from natural fishing ground "**Open Access**".
- Farmers get more understanding and recognize about involvement in CFR management through demonstrative activities.

Article3. Management of CFR

CFR is actively operated and managed by the members selected through democratic election process. The members form a committee, namely CFR management committee. The committee is considered as a special working committee under supervision of village chief and commune council. Generally the scope of main works of CFR management committeeis;

- Follow to enforce by-law and rules& regulations of CFR as written in article 5,8 and 10.
- Check and improve fish pathways with the associated routes for fish migrationfrom CFR to paddy field, and water management in the CFR in collaboration with village chief and commune council.
- Promote and implement the project successfully, which contributes to wild fish enrichment taking good cooperation with concerned authorities, such as village chief and commune council, competent fisheries administration as well as other stakeholders including monks.

- Report to competent fisheries administration[6] primarily or relevant authorities in case if fisheries competent is not available for the intervention in case of illegal fishing activities found in CFR as mentioned in article 8 and 10.

Article4. Election for selecting CFR management committee members and their mandate

At least five (5) but if more numbers of committee members is recommendable to implement better management of CFR. Most of them selected from villagers through democratic election.The voting committee consists of the followings;

- Representatives from competent fisheries administration
- Village chief and commune council
- Elder villagers

A chief and twovice chiefs are to be nominated from the candidates of CFR management members. Mandate duration of CFR committee members is three (3) years.

Article5. Role of CFR managementcommittee

A chief and two vice chiefs shall arrange a committee together with other committee members. The roles of the committee are to carry out the following activities;

- Formulate annual action plan
- Prepare annual budget proposal
- Implement working activities based on the annual actionplan
- Fund collection of 500 Riel/family/month and finding of other fund sources (fine, grant, charity, and others)
- Evaluate all the activities implemented and make a report for competent fisheries administration
- Prepare annual financial report for competent fisheries administration and relevant donors

Article6. Role of Chief of CFR managementcommittee

The chief of CFR management committee shall make a report on the achievements and prepare a financial report on expenditures as mentioned in article 5 and then submit it to competent fisheries administration, other relevant donors, local authoritiesand villagers annually.

Article7. Condition offishing activities in CFR

a. Fishing in protected areas in large CFR is totally prohibited. Fishing activities outside of the protected area are allowed, but any fishing activities have to bedone in line with fisheries law (as shown in article 16 of the "Law on Fisheries")
b. Any kind of fishing gears/activities are totally banned in all year round, notably trapped-fish pit etc. along the fish pathway or associated channels.

Article8. Fishing activities in paddy fieldsand floodplains surroundingCFR

Family-scale fishing in paddy fields and floodplains surrounding the CFR is allowed by law and encouraged. The operation should comply with fishing regulation as clearly authenticated by FiA (See article 30 of "Law on Fisheries").

Article9.Regulations on other than fishing activities

Villagers have to cooperate and work together to maintainCFR. Precisely, there are several activities which are not allowed in CFR.Those are;

- Dumping garbage into or nearby CFR
- Drainage of sewage or waste water into the pond

Villagers have to prepare or renovate fish pathway before wet season starts.

[6] Fisheries Administration Sangkat, division, Cantonment, Inspectorate and FiA

Article10. Legal penalty and fine for illegal activities

CFR management committee has the rights to detain illegal fishing which are operated at the mouth of the fish pathway associated to CFR, in the fish pathway as well as inside CFR and the protected area of large CFR and paddy field, and then report to competent fisheries administration to decide fine penalty based on the law enforcement as shown in the following table.

Electro Fishing	Law enforcement: Article 98 in Bullet 4, Law on Fisheries
Bamboo fencing	50,000 Riels/case
Dynamite fishing and trawling	20,000 Riels/case
Plunge basket or cover pot (Ang Ruth), common hook line, spear, small vertical cylinder trap (Saiyoein), brush bundle basket (Chhneang tram), turbular trap (Chuch), trap (Lorb), and water pumping or dry out of water body (Boum Bach)	10,000 Riels/case
Cast net (Samnanh) and fish net with mesh size is smaller than 3 mm	3,000 Riels/case

If officers of local authorities, other competent authorities such as police, army etc. involved in any activities related to illegal fishing activities or the officers don't take any action for the illegal/offensive activities taken by others even they find those penal acts, this case is also to be considered as an offence. The penalty imposed to this case shown in the Article No. 102 of the Law on Fisheries.

With regards to written by-law and rules& regulations as well as penalty informed above, this regulation would be endorsed and all activities of CFR management committee could be supported continuously.

Date: ……..(day)/……..(Month)/……(year)

Chief of CFR

Shownand submitted to commune head for decision

Date: ……..(day)/……..(Month)/……(year)

Village Chief

Shown and submitted to district governor for decision

Date: ……..(day)/……..(Month)/……(year)

Commune Head

Shown and approved

Date: ……..(day)/……..(Month)/……(year)

District Governor

Shown and approved

Date: ……..(day)/……..(Month)/……(year)

Director of Fisheries Administration Cantonment

Agreement

on

Signature of village chief and member of CFR

Name of CFR:……village……commune……. district, ……province

Approval of the agreement on the CFR indicated in thetable below;

No.	Name	Sex	Age	Role of community	Role of village chief	Right Thumb	Telephone number
1				Chief			
2				Vice chief			
3				Vice chief			
4				member			
5				member			
6				member			
7				member			
8				member			
9				member			
10				member			

Shownand approved

Date: ……..(day)/……..(Month)/……(year)

Village Chief

Shown and approved

Date: ……..(day)/……..(Month)/……(year)

Commune Head

ANNEX 7

(Final Report)

Manual on Seed production technique (results of verification)

Manual for Seed Production of Silver barb, Silver Carp, Mrigal and Common Carp with Special Reference of All Seed Production of Nile Tilapia

Toek Vil Aquaculture Research Center,

Siem Reap, Cambodia

Freshwater Aquaculture Improvement

Extension Project Phase II

2015

Preface

Agricultural productivity in Cambodia still remains low due to perpetual natural disasters such as floods and drought limiting rural farmers' income sources and sometimes causing nutrition deficiency. Under such a situation, improvement of livelihood as well as nutritional condition is considered as an urgent issue to be addressed. On the other hand, rural farmers expect freshwater aquaculture to be a part of their farming system and an additional source of protein and cash income. The Project aims at the low-input aquaculture promotion among rural farmers through the training of seed producing farmers, in order to alleviate poverty and to improve the nutrition of small-scale farmers. JICA is expected to utilize its experience in the similar aquaculture projects implemented in Southeast Asian countries. The target fish will be those species that are easy to grow utilizing earthen ponds, irrigation canals and paddy fields. To achieve higher efficiency, effectiveness and sustainability, the Project will take an approach to promote farmer-based extension system, in which selected prominent fish farmers are trained as seed producing farmers who will not only produce and supply fish seeds but also transfer skills and knowledge on aquaculture to small scale farmers.

On the basis of above policy, developed and improved seed production and grow-out technologies on indigenous and extension species are carried out and its its effectiveness are verified at farmers in the southern four states of Prey-Veng, Takeo, Kompong Speu and Kampot as implemented by Freshwater Aquaculture Improvement and Extension (FAIEX) Project Phase I from 2005 to2010 and in north three states of Pursat, Batanban and Siem Reap as implemented by FAIEX project Phase II from 2011 to 2015.

This manual described the seed production of indigenous species such as Silver barb, Silver carp, and Mrigal and Common carp, and with special reference of all male seed production of Tilapia developed and improved technically at Toek Vil Aquaculture Research Center, Siem Reap implemented by FAIEX project Phase II. We hope that this manual helps in the adoption of indigenous and extension species of the technology and lead to expansion of aquaculture in Cambodia.

Contents

1. Broodstock and feeding management

1.1 Geographical distribution and feeding habits

1.1.1 Silber barb *Barbonymus gonionotus* Cambidian name: Chipin (Pic. 1)

Distribution of Silber barb is Mekong basin in Laos, Thailand and Cambodia, Chao Phraya basin; Malay Peninsula, Sumatra, Java. Habits are found at mid-water to bottom depths in river, streams, flood plains, and occasionally in reservoirs. Feeding habits are taken on both plant and animal matter. Females grow faster than males.

1.1.2 Silver carp *Hypophthalmichthys molitrix* Cambidian name: Kap So (Pic. 2)

Silver carp originally distributes in China and eastern Siberia, and then introduced throughout the world. Feeding habit is Phtoplanktophagous. The gills have a complex network and profusion of closely set gill rakers. The gut of adult fish is 15 times the body length. Silver carp naturally occurs in the river system. The fish does not spawn naturally in ponds and tanks. Cooked Silver carp is used to guests at a wedding reception.

1.1.3 Mrigal *Cirrhinus cirrhosis* Cambidian name: Kap India (Pic. 3)

Mrigal originally distributes to large rivers in the Indian subcontinent, and then introduced into the Mekong. This species is a detritus eater, subsisting mostly on decayed vegetation.

1.1.4 Common carp *Cyprinus carpio* Cambidian name: Kap Samine (Pic. 4)

Common carp originally distributes from eastern Europe and western central Asia, and then is introduced into temperate and tropical counties for aquaculture. They are ominous, consuming a wild variety of plant and animal matter.

Pic. 1. Silver barb (350g)

Pic. 2. Silber carp (1.2kg)

Pic. 3. Mrigal (1.6kg)

Pic. 4. Common carp (2.8kg)

1.1 Growth

Fig. 1 indicates the growth of carps such as Silver barb, Silver carp, common carp and Mrigal. Common carp show the highest growth, and then next is Silver barb and Mrigal. Silver carp indicates the lowest growth. Silver barb, Silver carp, Mrigal and Common carp reach to 280g, 180g, 320g and 260g in body weight at 19 months after stocking, respectively.

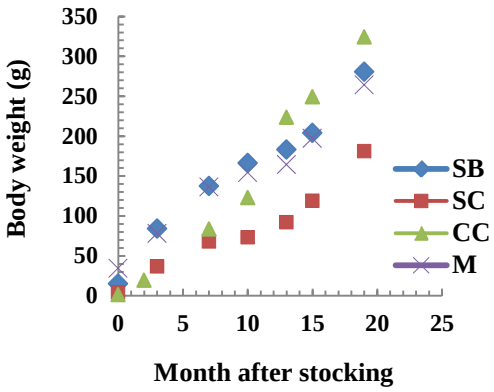


Fig. 1. Growth of Silver barb (SB), Silver carp (SC), Common carp (CC) and Mrigal (M) fed with 20% protein content feed.

1.3 Maturation

Regarding the time of first maturation, only silver barb and common carp both in the male and female mature at approximately 6-7 months after stocking juveniles in the grow-out pond. The sizes of common carp and silver barb are about 80g and 140g in body weight respectively. Male Mrigal matures at 7 months after stocking juvenile. Female however have not matured yet, and then matures at 19 months with the body

weight of 250g. The fact is that it is recommended to use broodstock reared at least for 19 months in the pond, because the size is enough to use as broodstock. It is necessary that silver carp however need one year more (at third year) for the maturation.

1.4 Broodstock management

1.4.1 Pond management

It is necessary that they should be reared in earthen pond with the size of more than 200 ㎡ and the depth of at least 1.0m.

Regarding pond arrangement of species, it is necessary to prepare two-individual ponds for male and female Silver barb due to lay eggs in case of mix culture. Concerning other species such as Silver carp, Mrigal and Common carp, it is possible to prepare two ponds for mono-culture of each male and female. Stocking density must be approximately 0.5kg/㎡. It is better to manage regularly change about 30% of pond water once monthly for the environmental improvement of pond (Table 1).

1.4.2 Feeding management

Regarding feeding management, formulated diet is fed to brood fish through a year. One is diet contained 30 % protein fed from November to March for maturing stage of gametes, and from April to September for mature stage of gametes. Another is diet containing 20% fed on October-November for resting stage of gametes to recover fish condition after spawning trials. All materials for formulated diet are available locally. It is recommended that feeding rate should be approximately 2.0% of total body weigh in each pond (Table 2).

Table 2. Schedule of broodstock management.

Items	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Oocytes:	Maturing stage					Mature stage					Resting stage	
Spawning season:												
Feeding scheme:				30% protein feed							20% protein feed	
				Fish meal	31					Fish meal	14	
				Pellet (30%)	31					Pellet (30%)	14	
				Rice bran	26					Rice bran	60	
				Broken rice	10					Broken rice	10	
				Pre-mix	2					Pre-mix	2	
				Price ($)/kg	0.69					Price ($)/kg	0.49	
Water management:						30% changing water once a month						
Stocking density:	0.5kg fish/m2											
Feeding amount:	2.0% of total fish body weight											

1.4.3 Making of home-made feed

First, broken rice is cooked with little water as binder. Next, artificial feed is added and cooked until diet becomes soft. Afterword, fish meal and rice bran are added. At last, vitamin is added when cooked diet becomes cold. Cooked diet becomes almost double from dry material in weight (pic. 5).

a. Paste form of broken rice as binder

b. Add 1mm pellet , expect to increase nutritional value

c. Add fish meal as main protein source

d. Add rice bran

e. Mixing well

f. At last, add pre-mix vitamin after getting cold of feed

2. Broodstock preparation for spawning trials

2.1 Selection

At first, it is necessary to separate male and female fish for the spawning trials. During spawning season, berried female fish shows abdomen full of egg. Male fish has running milt from genital pore. Another way, male fish show the appearance on the rough surface of pectoral fin. On the other hand, female fish has smooth surface of pectoral fin.

Regarding female fish, it should be select the fish with soft and swollen abdomen by the hand pressing. Male shows running milt by the light hand pressing near portion of genital pore. Of cause, they are not wound and should be look healthy.

2.2 Stocking rate between male and female

Concerning stocking of broodstock in the spawning tank, it is important that a total weight of male and female fish should be same. In case of Silver barb and Common carp, the number of male fish is more than female, because female fish is bigger than male. On the other hand, Mrigal and Silver carp are almost same number and body weight between male and female.

3. Spawning induction

3.1 Hormone

Hormone injection is necessary for spawning induction of carps. In Cambodia, Suprefact/Molilium-M and HCG are well used as famous hormone (Pic. 6), the former can purchase from Thailand, while HCG can be purchase from Vietnam. Superfact/Motilium-M is all–round hormone for the spawning induction of carps, while use of HCG is limited, only it is known as the hormone for the spawning induction of catfish and silver carp.

Pic.6. Suprefact (Center/Back), Motilium-M (Left/Front: China;Right/Front: France) and HCG (Left/Back: China; Right/Back: France).

3.1 Expire date and country brand of hormone

Suprefact: Suprefact is the medicine for the medical treatment of prostatic carcinoma etc. and an analogue of the natural gonadotropin (GnRH, HLH-RH). Ingredient is buserelin (1ml contain 1.05mg buserelin).

This hormone originally came from France and Germany. Recentry made in China can be found in Thailand market. Those Suprefact can purchase in Thailand, not in Cambodia. The quality and effect of different source of brand are same. It is attention that the hormonal effect is not recognized when expire date is moving closer in maturity.

Motilume-M: In addition, Suprefact can not use alone for the induction of spawning. It is necessary with the cooperation to Motilium for the success of spawning induction. Motilium made in France is not effect to spawning induction, so that it should purchase the effective Motilium-M made in Thailand. Both Motilium are the medicine for the medical treatment of stomachache. Ingredient is donperidone.

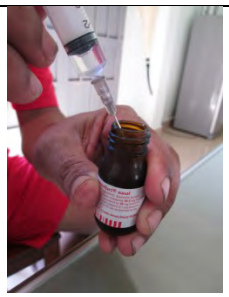
HCG (Human chorionic gonadotropin): HCG is the medicine for the medical treatment of pregnancy. Two kind of brand can be found in Cambodia. One is made in France for human being use, and can purchase in pharmacy. Another is made in China, can purchase in Vietnam. This hormone is for the spawning induction of fish. Both HCG are same effectiveness for fish spawning induction.

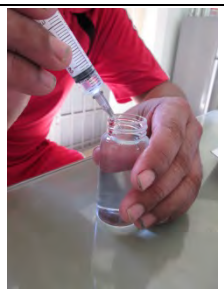
3.2 The prescription of Suprefact/Motilium-M

1) Prepare Suprefact, Motilium-M, Syringe, Mortar, 0.9%NaCl, small bottle (50ml) (Pic. 7).
2) Prepare the solution of 20 μg-Suprefact and 10mg/Motilium-M respaectively. At first, take 1ml of Suprefact from the bottle by syringe (Pic. 8), and dilute with 49ml of 0.9%NaCl solution as S solution (20 μg-Suprefact**:**50ml) (Pic. 9).
3) Next, take 50 tables (500mg) of Motilium-M and then grind it down by mortar (Pic. 10) and the Motelium powder is transferred to 50ml bottle (Pic.11).
4) Then, dilute Motilium-M powder with 0.9%NaCl solution and just make up to 50ml as M solution (10mg-Motilium-M: 50ml)(Pic. 12).
5) For convenient way for the injection to fish, make mixture with S- and M-solutions as SM solution (20 μg-Suprefact with 10mg/Motilium-M: total 100ml) (Table 2).
6) In case of 0.6kg fish, for example, take each of 0.6ml of S- and M-solution by the syringe individually, then inject to fish one by one (Table 2).

7) On the other hand, in case of mixture of S- and M-solution as SM-solution, we can inject 0.6ml SM-solution to the fish (Table 2).
8) In case of dose on 10 μg-Suprefact with 5mg-Motilium-M for 0.6kg fish, take 1.2ml SM-solution (Table 2), and then inject it to fish.
9) In case of dose on 40 μg-Suprefact with 20mg-Motilium-M solution for 0.6kg fish, take 2.4ml SM solution (Table 2), and then inject it to fish.

Pic. 7. Materials for spawning induction.


Pic.8. Take 1ml of Suprefact by syringe.


Pic.9. Transfer 1ml of Suprefact to 49 ml of 0.9%NaCl.


Pic.10. Granding Moterium-M using mortor.


Pic.11. Transfer Moterium-M powder to bottle.


Pic.12. Add 0.9%NaCl to powder of Moterium-M, make 50ml solution.

Table 2. Relationship between amount (ml) of Suprefact + Motilium-M and body weight (kg) of fish for spawning induction.

Fish weight (kg)	Suprefact* + Motilium-M**								
	Original solution (MS)			a half dilution of MS			Double amount of MS		
	20ug/kg fish *	10mg/kg fish **	20ug*+10mg**/kg fish	10ug/kg fish *	5mg/kg fish **	10ug*+5mg**/kg fish	40ug/kg fish *	20mg/kg fish **	40ug*+20mg**/kg fish
0.1	0.1ml	0.1ml	0.2ml	0.05ml	0.05ml	0.1ml	0.2ml	0.2ml	0.4ml
0.2	0.2	0.2	0.4	0.10	0.10	0.2	0.4	0.4	0.8
0.3	0.3	0.3	0.6	0.15	0.15	0.3	0.6	0.6	1.2
0.4	0.4	0.4	0.8	0.20	0.20	0.4	0.8	0.8	1.6
0.5	0.5	0.5	1.0	0.25	0.25	0.5	1.0	1.0	2.0
0.6	0.6	0.6	1.2	0.30	0.30	0.6	1.2	1.2	2.4
0.7	0.7	0.7	1.4	0.35	0.35	0.7	1.4	1.4	2.8
0.8	0.8	0.8	1.6	0.40	0.40	0.8	1.6	1.6	3.2
0.9	0.9	0.9	1.8	0.45	0.45	0.9	1.8	1.8	3.6
1.0	1.0	1.0	2.0	0.50	0.50	1.0	2.0	2.0	4.0
1.1	1.1	1.1	2.2	0.55	0.55	1.1	2.2	2.2	4.4
1.2	1.2	1.2	2.4	0.60	0.60	1.2	2.4	2.4	4.8
1.3	1.3	1.3	2.6	0.65	0.65	1.3	2.6	2.6	5.2
1.4	1.4	1.4	2.8	0.70	0.70	1.4	2.8	2.8	5.6
1.5	1.5	1.5	3.0	0.75	0.75	1.5	3.0	3.0	6.0
1.6	1.6	1.6	3.2	0.80	0.80	1.6	3.2	3.2	6.2
1.7	1.7	1.7	3.4	0.85	0.85	1.7	3.4	3.4	6.8
1.8	1.8	1.8	3.6	0.90	0.90	1.8	3.6	3.6	7.2
1.9	1.9	1.9	3.8	0.95	0.95	1.9	3.8	3.8	7.6
2.0	2.0	2.0	4.0	2.00	2.00	2.0	4.0	4.0	8.0

4 Spawning

3.1 Tanks

Carps do not select any shape of tank whether it is circle (Pic. 13), rectangular (Pic. 14) or oval in shape for their spawning activities and lay eggs. Spawning trials are usually conducted in 2-5 ㎥ tanks with 40-50cm depth water.

Pic. 13. Circular tank (2.8m dia.).

Pic. 14. Rectangular tank (4x1.8m).

3.2 Water source

Water source is from pond, reservoir, grand water and tap water. The pH of water should be more than 7.0, because spawned egg does not hatch if pH is acidic like less than 5.0. It is necessary that small amount of flowing water more or less 20L/min should be set up for stimulation making spawning induction. Circular tank clearly creates the water current along the wall, however rectangular tank directly

make the current from inlet side to outlet side. Two-three aeration is set up on the bottom of tank for making float up of layed eggs.

3.3 Injection

Hormone injection is done intramuscularly, in dorsal part of fish created swollen part (Pic. 15). It is considered that only one time injection is enough to occur spawning for Carps.

For female broodstock: It is necessary to induce breeding using proper dose of hormone from the viewpoint of economy. Silver barb and Mrigal need the dose of 10 μg -Suprefact/5mg-Motilium-M per kg fish for spawning induction. Silver carp need the dose of 20 μg-Suprefact/10mg-Motilium-M, and Common carp need the dose of 40 μg -Suprefact/ 20mg-Motilium-M.

Pic. 15. Hormone injection in dorsal part of fish created swollen part.

For male broodstock: Dosages of Sprefact/Motilium-M for male broodstock are usually injected by a half dose of female broodstock.

3.4 Time require from hormone injection to spawning

Time require from hormone injection to occurrence of spawning take 5 hours for Silver barb, 7 hours for Common carp and Silver carp, and 8 hours for Mrigal. From the view point of above findings, injection should be done at least from 9 o'clock to 10 o'clock in the morning, so that spawned eggs can transfer from spawning tank to incubation tank before sunset.

3.5 Amount of spawned eggs

Regarding amount of spawned egg, it is estimated that Silver barb spawns approximately 10L (n=5) per kg fish, Mrigal has about 12.5L (n=5), and Silver carp spawn about 8.2L (n=4) per kg fish. Number of spawned eggs estimate to be roughly 70,000 eggs for Silver barb, 40,000 eggs for Mrigal and 25,000 eggs for Silver carp per 1kg fish, respectively.

3.6 Characteristic of spawned eggs

Spawned eggs of Silver barb, Silver carp and Mrigal absorb water into the egg, and then bulge with water. They drift separately in the water, on the other hand, eggs of Common carp is adhesive and attach to the any floating substrates in the water (Pic. 16).

Sizes of spawned egg are 2.6mm in Silver barb, 4.3mm in Silver carp, 6.0mm in Mrigal and 1.3mm in Common carp respectively.

Pic. 16. Eggs of Common carp attached to floating substrate.

4 Fertilization

4.1 Accommodation of fertilized eggs

Drifting spawned eggs are collected by large scope net made from fine-mesh close (Pic. 17). Adhesive eggs of only common carp are collected from egg collector (Pic. 16). The accommodation of floating and adhesive eggs into incubation tank s depend on the specie. A incubation tanks is 300L-tank with 1.2m diameter and should be round shape with moderate water supply from lower position of tank with center outlet (Pic. 18), so that eggs are stir with swirling around the wall of tank.

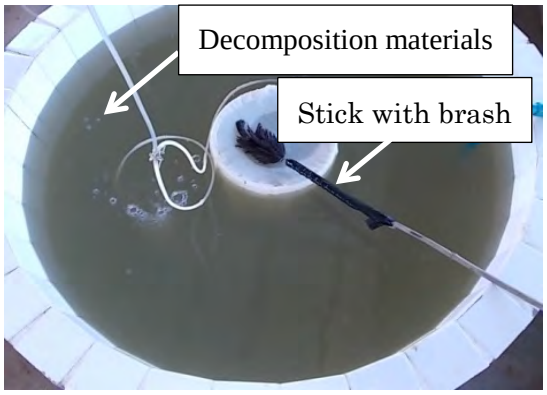
In case of Silver barb, Mrigal and Silver carp eggs accommodate 1.3L/100L-water, 1.0L/100L-water, and 0.6L/100L-water respectively.

Pic. 17. Collection of floating eggs using large fine scope net in the spawning tank.

Pic. 18. Incubator (1.2 m dia.) with center outlet.

4.2 Management of fertilized eggs

Supply of continuous water and removing contaminated materials are most important for the management of egg incubation. Decomposition materials consisting of unfertilized egg and egg membrane after hatching are one of the main causes. Countermeasure of larval mortality is to remove decomposition materials frequently using stick with brash (Pic. 19), and continue moderate water supply with running water should be supplied.



Pic. 19. Removing of decomposition materials.

It is recommended that the exchange rate of water should be more than 10L per minutes and checking of water current and exchange rate of water should be checked every time until releasing fry to the nursery pond.

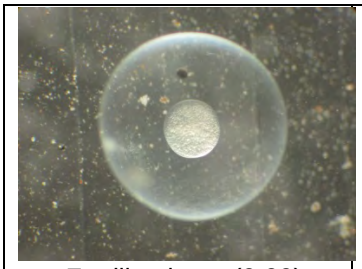
Fertilized eggs distribute bottom layer of incubator, while unfertilized egg float in upper layer. Therefore air ration system is necessary to assist to float them up and also supply oxygen. Couse of mortality after hatching infer from water pollution.

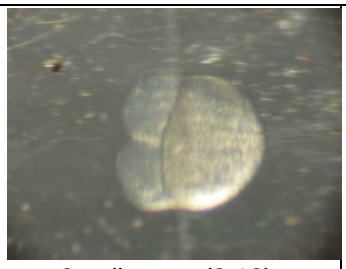
4.3 Deferent development stages of egg

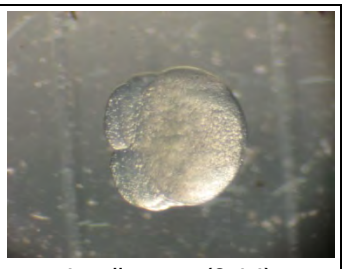
Pic. 20, Pic. 21, Pic. 22 and Pic. 23 indicate the development stages of Silver carp, Silver carp, Mrigal and common carp eggs respectively (WT:28-31℃).

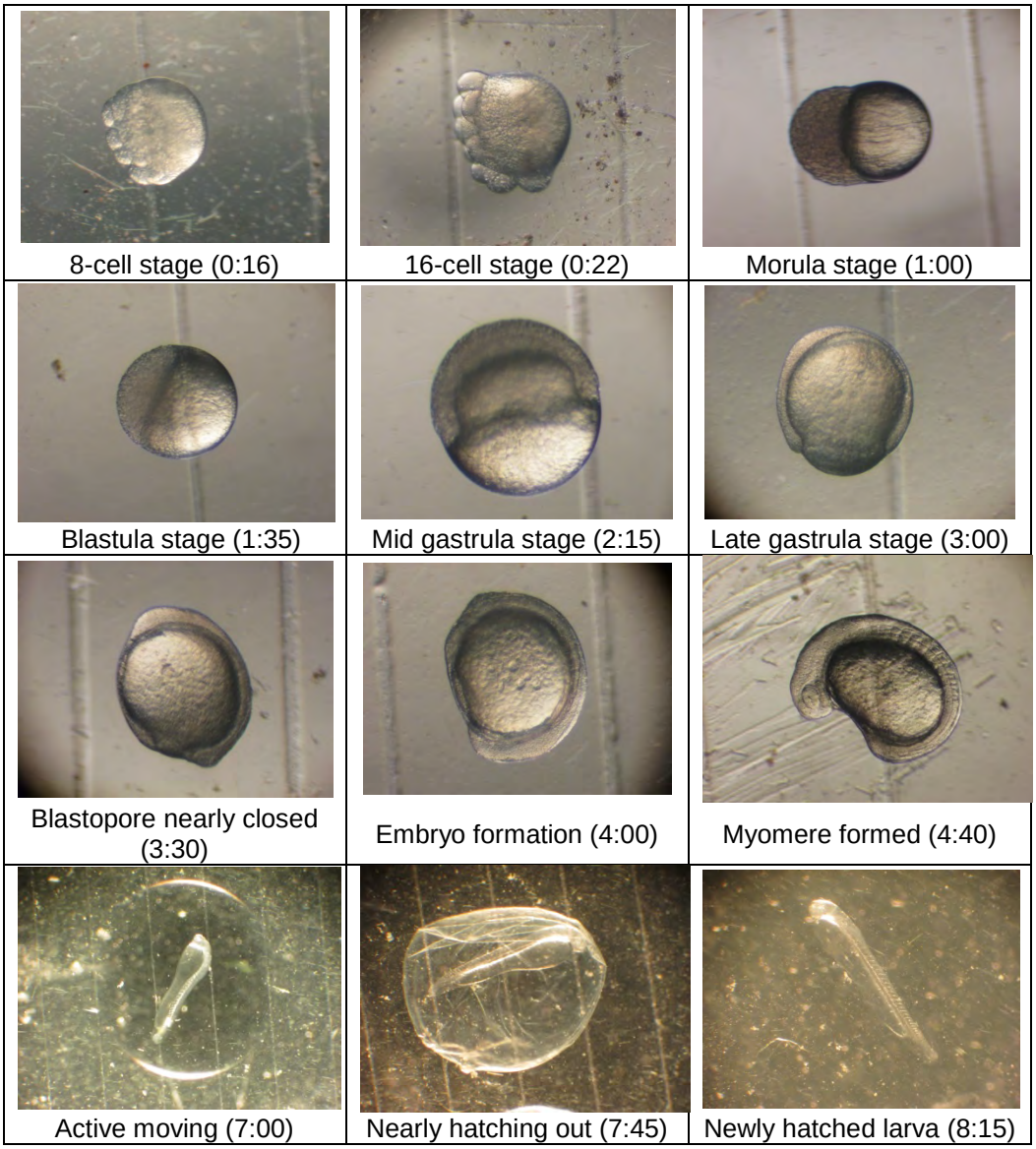
4.1.1 Development stages of Silver barb eggs

Egg shows spherical and drifting in the water. Egg diameter is about 3.4mm after absorbing water. The egg stage from Fertilization to D-shape stage takes only for about 4 hours. Hatching takes about 7.5 hours after fertilization. Newly hatched larva is 2.6mm in total length.


Fertilized egg (0:00)


2-cell stage (0:12)

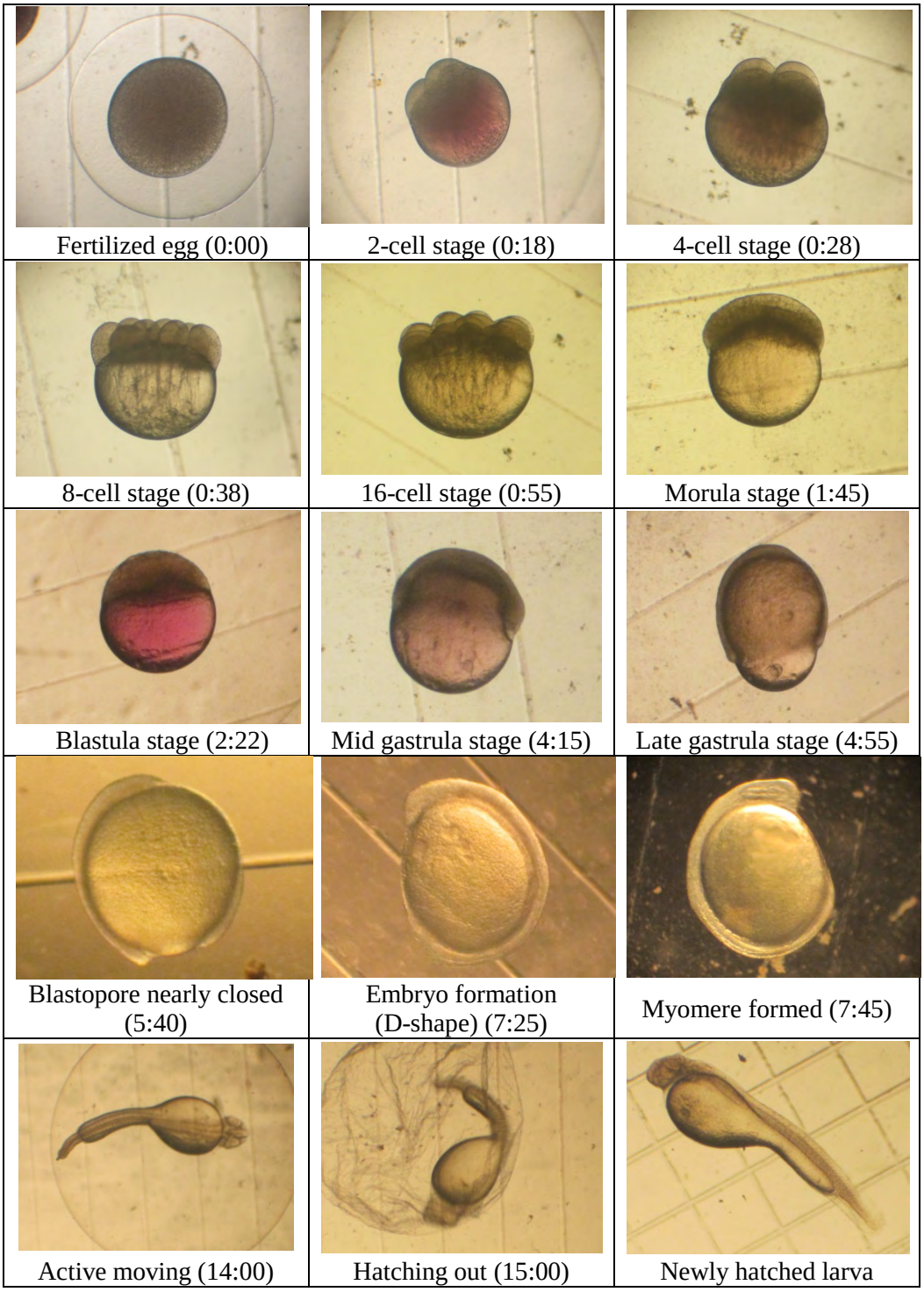

4-cell stage (0:14)



Pic. 20. Different developmental stages of Silver barb eggs.

4.3.1 Development stages of Silver carp eggs

Egg shows spherical and drifting in the water as same as Silver barb. Egg diameter is about 4.3mm after absorbing water. The egg stage from Fertilization to D-shape stage takes for about 7 hours. Hatching takes about 15 hours after fertilization. Newly hatched larva is 4.3mm in total length.

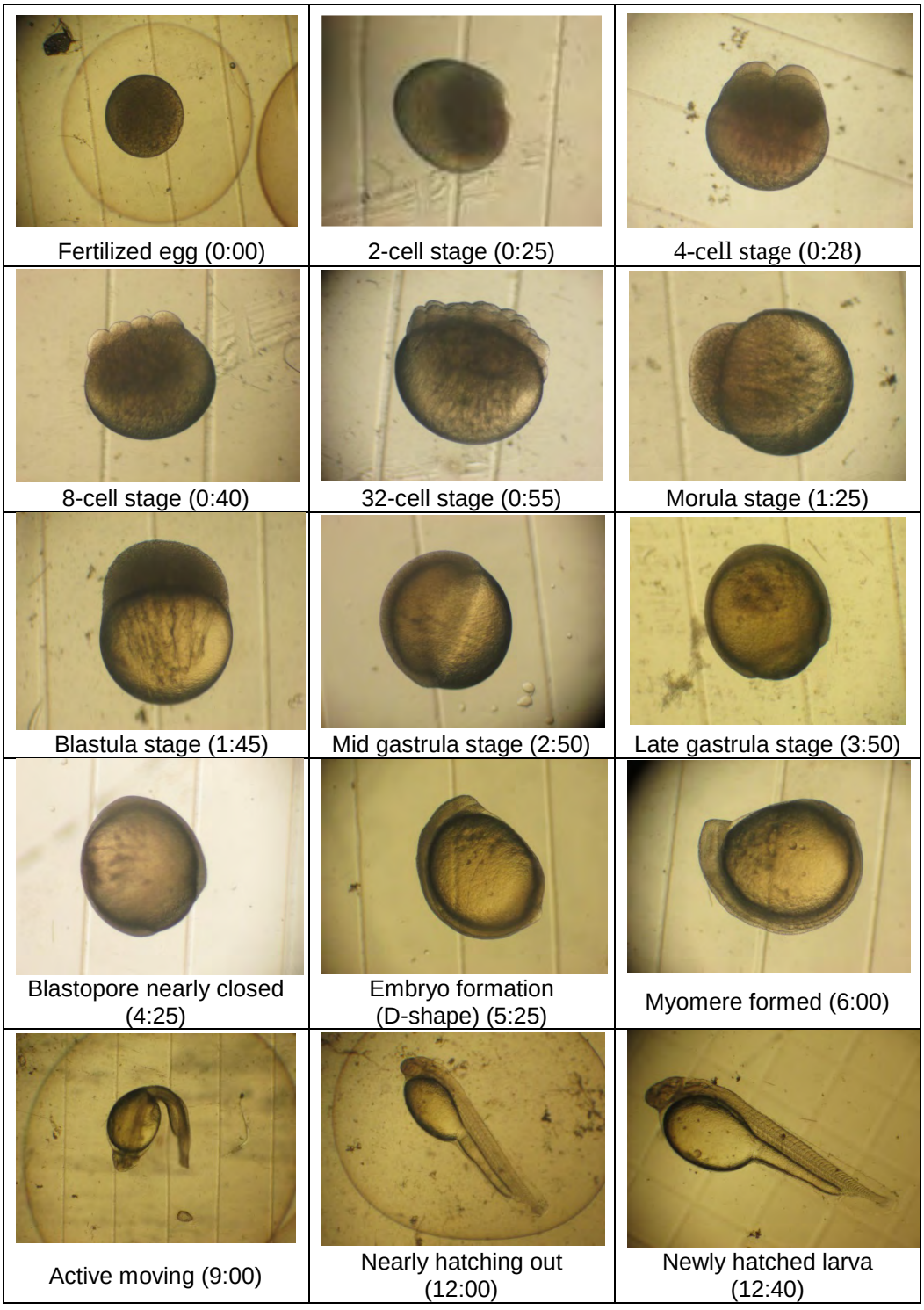


Pic. 21. Different developmental stages of Silver carp eggs.

4.3.3 Developmental stages of Mrigal eggs

Egg shows spherical and drifting in the water as same as Silver barb and Silver carp. Egg diameter is about 6mm after absorbing water. The

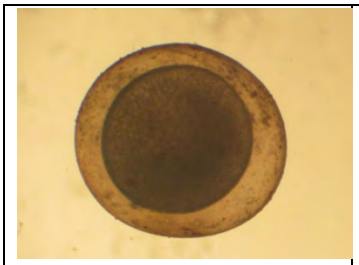
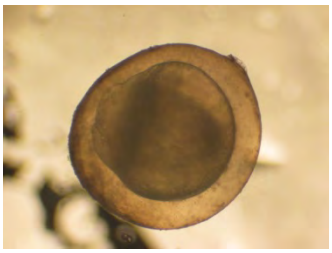
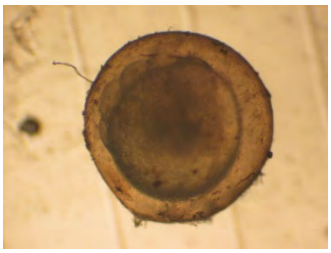
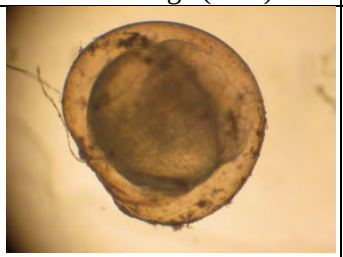
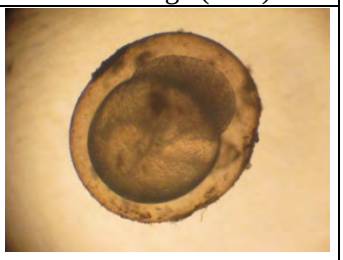
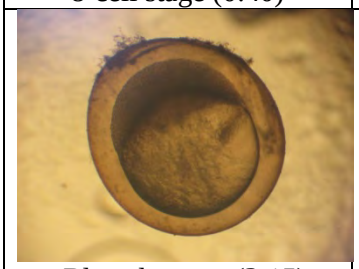
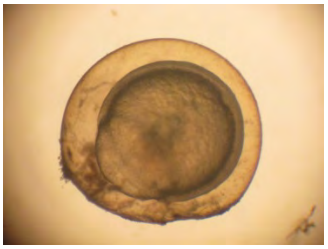
egg stage from fertilization to D-shape stage takes for about 7 hours as same as Silver carp. Hatching takes about 15 hours after fertilization almost as same as Silver carp eggs. Newly hatched larva is 4.5mm in total length.



Pic. 22. Different developmental stages of Mrigal eggs.

4.3.3 Development stages of Common carp eggs.

Egg shows spherical, adhesive and sinking attached to substrates. Egg diameter is about 1.3mm. The egg stage from fertilization to D-shape stage takes for about 9 hours. Hatching takes about 35 hours after fertilization. Newly hatched larva is 4.5mm in total length.

 Fertilized egg (0:00)	 2-cell stage (0:30)	 4-cell stage (0:35)
 8-cell stage (0:40)	 16-cell stage (0:50)	 Morula stage (2:15)
 Blastula stage (3:15)	 Mid gastrula stage (5:15)	 Late gastrula stage (6:15)
 Blastopore nearly closed (7:00)	 Embryo formation (D-shape) (9:00)	 Myomere formed (9:30)


Active moving (16:30)


Hatching out (35:15)


Newly hatched larva

Pic. 23. Different developmental stages of Common carp eggs

4 Hatching

5.1 Time of hatching required from lay eggs

Time of hatching required from lay eggs is not same between species. The longest time required from lay egg is Common carp, and it takes 36 hours. Next longest time is Silver carp, and it takes 16 hours. Mrigal takes 13 hours, and Silver barb is the shortest in time required from lay eggs, and it takes only 8 hours under water temperature of 28-31℃.

5.2 Timing of releasing fry into nursery pond

Timing of releasing fry into nursery shows the indication that fry almost consumes the yolk themselves, and mouth and anus open. Fry also starts to swim from horizontally to vertically. In this time, feeding behavior of fry changes to feed from internal nutrition to external nutrition. Silver barb fry (4.1mm TL) should be released to the nursery at 2 days old from hatching, and other fry such as Silver carp (7.3mm TL), Mrigal (7.3mm TL) and Common carp (7.7mm TL) and should be stocked at 3 days old after hatching (Pic. 24).


Day 2 Silver barb larva


Day 3 Silver carp larva


Day 3 Mrigal larva

Pic.24. Day 2 and Day 3 larvae needed initial feeding.

6. Larval rearing

6.1 Preparation of nursery

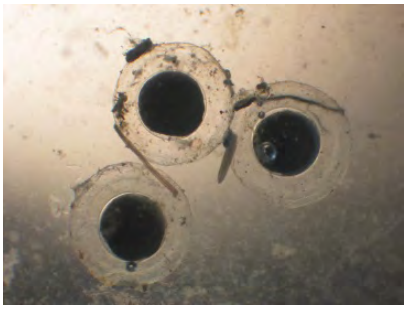
1) Pond should be dry and scatter lime (10kg/100 ㎡) before introduction of water.

2) Source of water is preferred from river, reservoir and pond. It takes 1-2 days for filling up water in the nursery pond. Depth of water is about 1m.

3) After filling up water in the nursery pond, it is better to fertilize into the pond using chicken manure (10kg) and DAP (1kg) per 100 ㎡ area of pond.

4) After fertilization into the pond, aquatic insect and frog start to propagate in the water. Especially, it should be attention to remove frog eggs layed along the wall of the pond, because large amount of frog larvae appear soon in the nursery pond if these are not removed before stocking fish larvae. At the same time, fish larvae compete with fiercely against frog larvae for feeding of natural animal feed such as Rotifer, Moina and Copepod etc. This is one of the most obvious causes to become low survival of culture fish. It is recommended that fence made from fine net should set up along the dike of the pond to protect entering adult frog. Layed frog eggs are long chain type (Pic. 25) under the water and individual floating type (Pic. 26) on the surface of water.

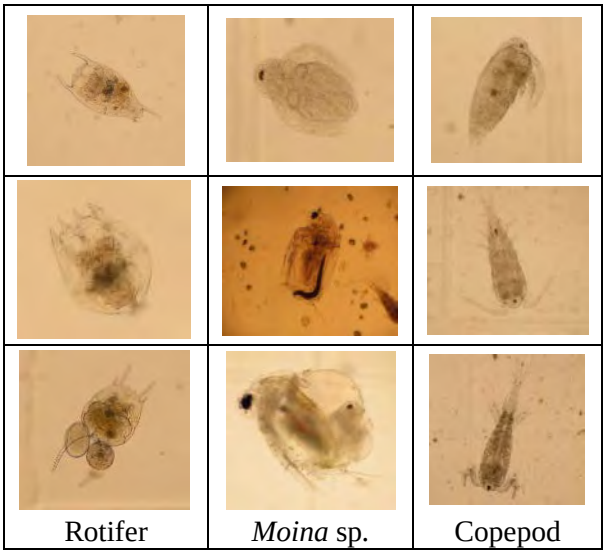
Pic. 24. Chain type of frog eggs.



Pic. 25. Floating type of frog eggs.

6.2 Management of nursery pond after stocking of larvae (Table 3)

1) Time on stocking at Day 2-3 days larvae, is agreed with time of propagation of natural zoo plankton such as rotifer, *Moina* and copepod (Pic. 27), mainly rotifer at 3 days after fertilization in the nursery pond (Fig. 2).



Rotifer | *Moina* sp. | Copepod

Pic. 27. Zoo-plankton (Rotifer, *Moina* and copepod) in the nursery pond.

2) It is recommended that stocking density of larvae should be less than 500 fish/m2 of pond area

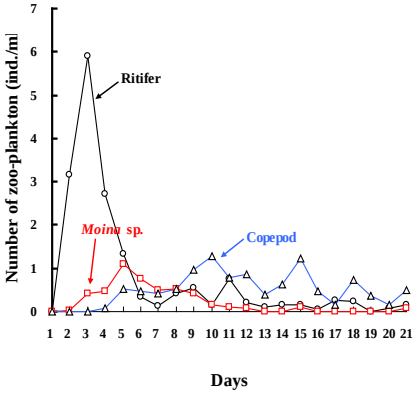


Fig. 2. Appearance of zoo-plankton after fertilization.

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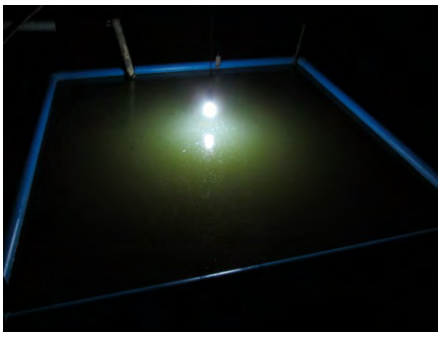
3) From the time of 3 days after stocking larvae, collection of aquatic insect, especially larvae of diving beetle (Pic. 28) is done using scoop-net under the lighting by the lamp set up beside the dike of pond at night. Aquatic insect gather under the lump. There is another method for capture of aquatic insect which is using diesel to kill aquatic insect. One is to scatter the diesel all over the pond water, and another is combination with use of diesel and lighting at night. The diesel is spread to the small compartment made of 2x2m pipe frame (Pic. 29), and lighting is done at night (Pic. 30). The diesel sticks to the body of insect when they swim up to the surface of water to take oxygen.

Pic. 28. Aquatic insect (Larvae of diving beetle).

Pic. 29. Spread diesel into the flame.



Pic. 30. Light up at night.

6.3 Feeding management

Feeding start to scatter wet type of fine fish meal (50g x 4times: 0800, 1100, 1330, 1700/ day /100 ㎡) and fine rice bran (50g x 4times: 0800, 1100, 1330, 1700/ day/ 100m2) to the pond for 20 days. It is expected that this scattering ingredients mean additional fertilization for the pond water and same time feed for fish larvae (Table 3).

From 21 days old larvae, feeding method changes from scattering to tray method, and it is recommended that commercial or home-made feed contented more than 20% protein is started to give larvae with the 15% of total body weight. Feed can be used whether home-made wet feed and/or commercial pellet 2 times a day (Table 3)

Table 3. New appropriate technology for the seed production management of carps.

<table>
<tr><th rowspan="2">Age</th><th rowspan="2">Common carp (CC)</th><th rowspan="2">Silver barb (SB)</th><th rowspan="2">Silver carp (SC)</th><th rowspan="2">Mrigal (M)</th><th colspan="2">Pond management</th></tr>
<tr><th>For CC, SC, M</th><th>For SB</th></tr>
<tr><td>D-(-3)</td><td colspan="4"></td><td></td><td>Drain/Lime (10kg/100㎡)</td></tr>
<tr><td>D-(-2)</td><td>Injection (0930): 40㎍-Suprefact+20mg-Motirium/kg fish, Spawning (1630)</td><td colspan="3"></td><td>Drain/Lime (10kg/100㎡)</td><td>Water</td></tr>
<tr><td>D-(-1)</td><td></td><td>Injection (0930): 10㎍-Suprefact+5mg-Motilium/kg fish, Spawning (1430)/ Hatching (2230)</td><td>Injection (0930): 20㎍-Suprefact+10mg-Motilium/kg fish, Spawning (1630)</td><td>Injection (0930): 10㎍-Suprefact+5mg-Motilium/kg fish, Spawning (1730)</td><td>Water</td><td>Chicken manure (20kg/100㎡), DAP (1kg/100㎡)</td></tr>
<tr><td>D-0</td><td>Hatching (0430)</td><td></td><td>Hatching (0730)</td><td>Hatching (0530)</td><td>Chicken manure (20kg/100㎡), DAP (1kg/100㎡)</td><td>D-1 (removing frog egg)</td></tr>
<tr><td>D-1</td><td colspan="4">Removing contamination materials</td><td>D-1 (removing frog egg)</td><td>D-2 (removing frog egg)</td></tr>
<tr><td>D-2</td><td></td><td>Stock to pond (0800-0900)</td><td colspan="2"></td><td>D-2 (removing frog egg)</td><td>D-3</td></tr>
<tr><td>D-3</td><td>Stock to pond (0800-0900)</td><td></td><td colspan="2">Stock to pond (0800-0900)</td><td>D-3</td><td></td></tr>
<tr><td>D-4</td><td colspan="4" rowspan="10">Fertilizing and/or feeding by scattering /Amount: Fine fish meal (50g x 4 times), and fine rice bran (50g x 4 times) a day for 100㎡ pond</td><td colspan="2" rowspan="3"></td></tr>
<tr><td>D-5</td></tr>
<tr><td>D-6</td></tr>
<tr><td>·</td><td colspan="2" rowspan="4">Removing aquatic insect at night
  </td></tr>
<tr><td>·</td></tr>
<tr><td>·</td></tr>
<tr><td>D-16</td></tr>
<tr><td>D-17</td><td colspan="2" rowspan="4"></td></tr>
<tr><td>D-18</td></tr>
<tr><td>D-19</td></tr>
<tr><td>D-20</td></tr>
<tr><td>D-21</td><td colspan="4" rowspan="6">Feeding by tray method: use > 20% protein content home-made feed or commercila feed, feeding amount: 15% of estimeted total body weight, and feeding 2 times a day</td><td colspan="2" rowspan="6"></td></tr>
<tr><td>·</td></tr>
<tr><td>·</td></tr>
<tr><td>·</td></tr>
<tr><td>D-52</td></tr>
<tr><td>D-53</td></tr>
<tr><td>D-54</td><td colspan="4"></td><td colspan="2"></td></tr>
</table>

6.3 Growth and survival

We practiced seed production of carps according as procedure showed in Table 3. Results indicated that comparatively good survival rate and growth were founded including carnivorous fish such as for example catfish. Survival rates indicate more than 10% respectively.

6.4.1 Silver barb

Growth of Silver barb seed shows in Fig. 3. Growth shows rapid increasing from hatching to Day 20. It is however slow down after day 20. Juveniles reach 25mm at 60 days after hatching. This growth pattern indicate relatively good survival rate of fish. Survival rate shows more than 16%. Relationship between total length and body weight of Silver barb shows in Fig. 4. Formula as follow: $y=1E\text{-}07x^{4.386}$ ($R^2=0.7877$)

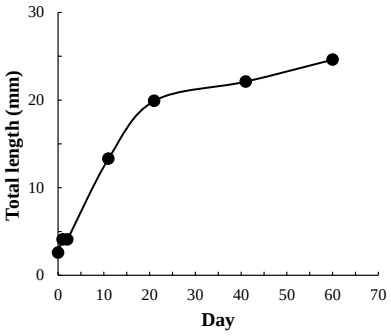


Fig. 3. Growth of Silber barb seed.

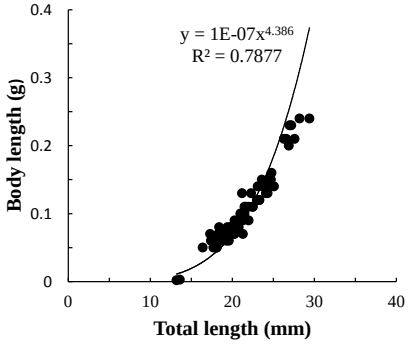


Fig. 4. Relationship between total length and body weight of Silver barb seed.

6.3.1 Silver carp

Growth of Silver carp seed indicates in Fig. 5. Growth shows normal increasing from hatching to Day 50. Juveniles reach 68mm at 50 days after hatching. Growth pattern also indicate good survival rate of fish. Good survival rate shows more than 25%. Relationship between total length and body weight of Silver carp shows in Fig. 6. Formula as follow: $y=9E\text{-}06x^{2.9979}$ ($R^2=0.8829$)

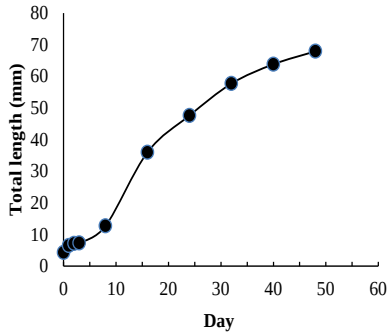


Fig. 5. Growth of Silver carp seed.

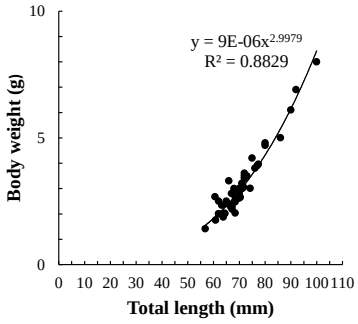
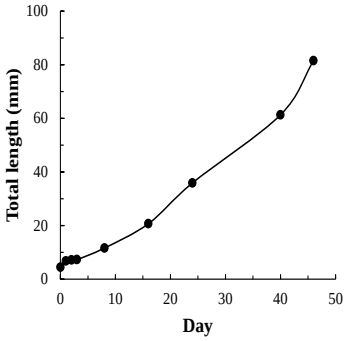


Fig. 6. Relationship between total length and body weight of Silver carp seed.

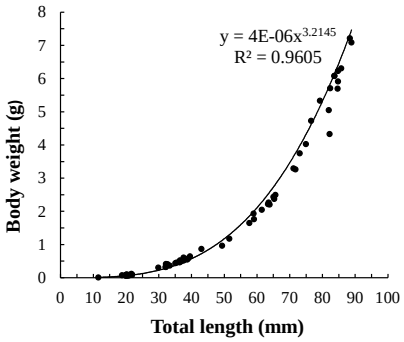
6.3.1 Mrigal

Growth of Mrigal seed shows in Fig. 7. Growth shows normal increasing from hatching to Day 46. Juveniles reach 53mm at 46 days after hatching. Growth pattern also indicate good survival rate of fish. Survival rate shows about 10%. Relationship between total length and body weight of

Silver carp shows in Fig. 8. Formula as follow: $y=4E\text{-}06x^{3.2145}$ ($R^2=0.9605$)



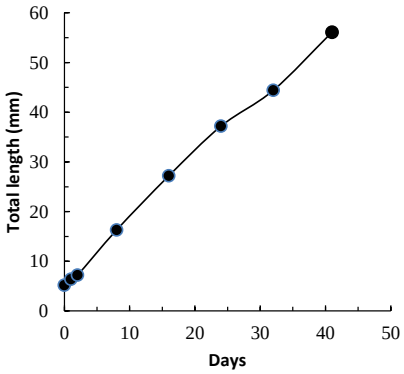
Pic. 7. Growth of Mrigal seed.



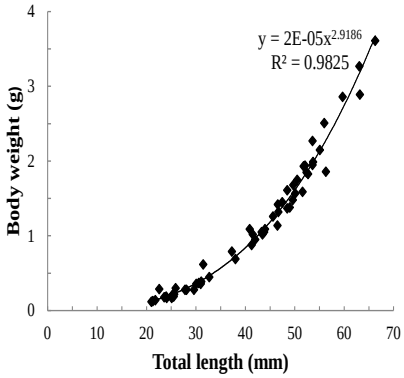
Pic.8. Relationship between total length and body weight of Mrigal seed.

6.4.4 Common carp

Growth of Common carp seed indicates in Fig. 9. Growth shows normal increasing from hatching to Day 41. Juveniles reach 56mm at 41 days after hatching. Growth pattern also indicate good survival rate of fish. The highest survival rate shows 35%. Relationship between total length and body weight of Silver carp shows in Fig. 10. Formula as follow: $y=2E\text{-}05x^{2.9186}$ ($R^2=0.9825$)



Pic.9. Growth of Common carp seed.



Pic. 10. Relationship between total length and body weight of Common carp seed.

7. Harvest and transport

Harvesting should be done in the morning that water temperature is not rising yet. Feeding is stopped one day before harvesting. The seed will be cough by the seine net (6

mm mesh) according as the order. Seeds are carefully carried from the pond to the shipping place by plastic container with water, and then seeds are transferred to stocking tanks. Do not carry the seed without water by scope net due to the happening by stress mortality later.

Regarding the transporting of seeds, we normally use the plastic bag (60 x100 cm; 10L water with oxygen gas), with stocking density of approximately 500 juveniles (3-5cm TL). The number of stocking fish per bag depends on the size of fish and transporting distance/ hours. Transport should be done early in the morning or late in the afternoon.

8. All male production of tilapia seed

Tilapia is a tropical fish species originating from Africa. Due to its popularity for aquaculture it has been introduced around the world and widely culture throughout the tropic and sub-tropics.

Tilapia is a common name for a group of three genera, *Oreochromis, Sarotherodon* and *Tilapia*, with the Nile tilapia, *Oreochromis niloticus* (Nile tilapia) (Pic. 31), generally considered the best species for freshwater aquaculture. The fish has many attributes suited to demonstration and culture including good flesh quality and flavor, wild tolerance of different environments, resistance to common fish diseases, and relative ease of reproduction in captivity.

Most of culture fish is harvested before maturity. On the other hand, tilapia is reared and harvested after maturity, so that tilapia culture occur the serious problem as follows:

1) The female grows slow due to the early maturation of female.
2) Appearance of reproduced fry and fingerling during the culture period. Consequently they intercept feed.
3) Lack of oxygen concentration in the pond due to the over stocking density.

Pic. 31. *Oreochromis niloticus* (Nile tilapia).

Advantage of all male culture is indicated as below:

1) All male culture is faster growth than the mix culture with male and female.
2) Appearance of reproductive seed is minimized.
3) Almost same size during rearing and harvesting.
4) Therefore FCR can be reduced and improved.

To produce all male of tilapia, 17 α - methyltestosterone (MT) hormone is used, because it is the most common and successful hormone for tilapia sex reversal at present. The hormones are incorporated into fry feeds. In this chapter, we describe how to produce MT seed.

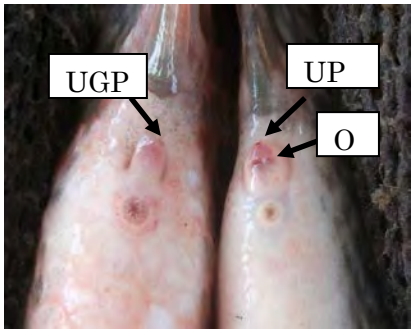
8.1 Spawning pond preparation

In the Toek Vil station, two-45 ㎡ ponds is used for the fry collection (Pic. 32). Pond is at first dry and put the lime of 0.1kg/㎡. After a few days, water is filled up. Afterwards, DAP was put at the rate of 0.1kg/㎡.

Pic. 32. Spawning pond for Tilapia.

8.2 Broodstock

Broodstock is selected by the use of manual sexing technique. The technique of manual sorting is based on assessing the number of opening in the genital papillae: the male has a single urinogenital (UGP) opening, while the female has two separate opening (urinary pore: UP and oviduct: O) (Pic. 33).



Pic.33. The male (Left), the female (Right). Arrow shows the opening in the genital papillae.

Generally, the male is bigger than the female. For example, the female is small, averaging 250g, and the male is bigger than the female, averaging 350g. The stocking rate is 1-male : 3-females/㎡. Consequently, 45 males and 135 females broodstock can be stocked for a 45 ㎡ spawning pond. Broodstock is stocked at the 3th days after fertilization by DAP.

8.3 Fry collection

Swim-up fry stars to appear near the surface around the pond at about 10th day after stocking broodstock (Pic. 34). The fry is < 10mm TL (Pic. 35) before gonadal differentiation has not begun. The fry is collected by the use of fine mesh scope net (Pic. 36), and then the fry is transferred to stock scope net for sorting and counting (Pic. 37). It is possible to collect the fry in the early morning at about 07:00. To collect a total of 30,000 fry from two-45 ㎡ ponds 10 consecutive daily.

Pic. 34. Appearing of swim-up fry.

Pic. 35. < 10mm TL swim-up fry

Pic. 36. Collection of swim-up fry by scoop net.

Pic. 37. Sorting and counting of collected fry.

8.4 MT-feed preparation

Step 1

1) Commercial feed (40% protein) is used.
2) Feed is grinded to 0.3-0.5 mm and 0.5-1.0 mm feed using 0.3, 0.5 and 1.0 mm mesh sieves according as fish size (Pic.38) .

Pic. 38. Sieving of commercial feed according as fish size.

Step 2

3) Dissolve 3 g of 17-α methyltestosterone (MT; Argent Chemicals) in 2 ℓ of 95% ethanol alcohol to prepare the stock solution (Pic. 39) .

Step 3

4) Thoroughly mix 200 ml of the stock solution with 1kg of mash feed using handy spray (Pic. 40).

Pic. 39. Chemicals for making MT-feed. MT (left) and Ethanol alcohol (Right)

Step 4

5) The moist feed is air dried out of direct sunlight and sometime stirred in the mixer until dry then stored in the container under dark (Pic. 41).

Pic. 40. Mixing feed and MT solution using a handy spray.

Pic. 41. Storing of MT-feed under dark.

8.5 Preparation of hapa

Before stocking the fry collected from the spawning pond, hapas are set up in the pond for stocking the collected fry for the MT feed feeding. The Hapa is the inverted commercial mosquito net. The size is 1.7x1.8x1.7 m with < 2mm mesh size. While floating feeding flame (0.6x0.6 m) is made by the wood, and is set up in the center of hapa in order to protect the scattering of powder feed.

8.6 The fry and feeding management

Four thousand counted swim-up fry is transferred and stocked into a hapa (Pic. 42). Afterwards, feeding is started and MT feed is given according as the fish growth. Table 4 shows the feeding scheme for sex reversal of tilapia fry. Feeding is done 4 times daily for 3 weeks. In every week, the stocking density of fry is reduced from 4,000 fry to 2,000 fry in the 2nd week, and then from 2,000 fry to 1,000 fry in the 3rd week. Consequently 4 hapas are needed for 4,000-MT seed production. Fry after 3 weeks old is released directly to the pond. Survival is expected to be >90%, and fish

Pic. 42. Hapa net (2x2m) for rearing fry of Tilapia.

reach to approximately 0.3 g. In this time forward, normal feed without MT is given to fish.

Table 4. Rearing management for hapa net (2x2m) rearing.

Age (old)	Initial fry	Feed (g)/4 times a day	Feed size (mm)	No. of fry in a hapa (2.0x2.0x1.5m)			
1st week	4,000	9	0.3-0.5	4,000			
2nd week		38	0.5-1.0	2,000		2,000	
3rd week		60	0.5-1.0	1,000	1,000	1,000	1,000

After releasing fish from hapa to pond, feed is given at the rate of 15% of body weight for one month. Afterwards the feeding amount is reduced according as the fish growth from 15% to 4% in body weight. Tilapia attains approximately 50 g size after 3 month rearing. Feeding is given 3 times a day using commercial feed containing 0.5 and 1.0mm pellet (40% protein). Appearance of male performs 99%.

8.7 Harvest and transport

Harvesting procedure is as same as its Carps. Harvesting should be done in the morning that water temperature is not rising yet. Feeding is stopped one day before harvesting. The seed will be cough by the seine net (6mm mesh) as the order. Seeds are carefully carried from the pond to the shipping place by plastic container with water. Do not carry the seed without water by scope net due to the happening by stress mortality later.

Regarding the transporting of seeds, method of MT treated Tilapia seed packing is as same as Carps seed. We also use the plastic bag (60 x100 cm; 10L water with oxygen gas) with stocking density of 1000 fry (2.5-3cm TL), and in case of MT treated 50g-tilapia transporting, the number of stocking is about 60 fish per bag. Transport should be done early in the morning or late in the afternoon.

ANNEX 8

(Final Report)

JCC Minutes

THE MINUTE OF THE FIRST JOINT COORDINATING COMMITTEE MEETING
CONCERNING
THE JAPANESE TECHNICAL COOPERATION
FOR
THE FRESHWATER AQUACULTURE IMPROVEMENT
AND EXTENSION PROJECT PHASE 2 (FAIEX-2)
IN
KINGDOM OF CAMBODIA

In accordance with articles of the Record of Discussions (hereinafter referred to as "the R/D") signed on January 10, 2011, Cambodia authorities concerned and the Project decided to hold the first Joint Coordinating Committee Meeting (hereinafter referred to as "the Meeting") on February 21, 2012.

During the Meeting, accomplishment from March 2011 to February 2012, work plan from March 2012 to February 2013, and proposed indicator in Project Design Matrix (PDM) were presented as the agenda of the Meeting.

Attendants of this meeting exchanged views and discussed in respect of necessary measures to be taken by both Cambodia and Japanese sides for further successful implementation of the Project.

The both sides of attendants concerned the Project agreed to recommend to their respective Governments the matters referred to in the document and the revised PDM attached hereto.

Phnom Penh, February 21, 2012

JAPAN INTERNATIONAL COOPERATION AGENCY JICA Cambodia

Mr. KOBAYASHI Yukiharu

Senior Representative
Japan International Cooperation Agency Cambodia Office

H.E Dr. Nao Thuok

Delegate of the Royal Government of Cambodia
Director General, Fisheries Administration, Ministry of Agriculture, Forestry and Fisheries

Project Director
The Freshwater Aquaculture Improvement and Extension Project Phase 2 in Cambodia

The MINUTES
OF
the 1st Joint Coordinating Committee Meeting on
"the Achievement of year 2011, Work Plan for year 2012, and Proper indicator for PDM (Project Design Matrix) of the Freshwater Aquaculture Improvement and Extension Project Phrase II"
21 February, 2012

On February 21, 2012 at 8:30 am at the Inland Fisheries Research and Development Institute, there is opening a meeting on "***Achievement of year 2011, Work Plan for year 2012, and Proper indicator for PDM (Project Design Matrix) of the Freshwater Aquaculture Improvement and Extension Project Phrase II***", that is under presidency of His Excellency **Por Try**, Secretary of State of the Ministry of Agriculture, Forestry and Fisheries.

List of participants is attached in **Annex 2**:

To begin, **Mr. Chinda**, Deputy Director of Aquaculture Development Department informed about the meeting program and objectives.

Next His Excellency **Dr. Nao Thuok**, Delegate of the Royal Government of Cambodia in charge of Director General of Fisheries Administration, delivered his welcome remarks to the whole workshop as in the attached document **Annex 3.**

- Welcome Address –

Mr. Kobayashi Yukiharu, Senior Representative JICA stated his remark as in the attached document **Annex 4.**

- Keynote speech-

After that **His Excellency Por Try**, Secretary of State of the Ministry of Agriculture, Forestry, and Fisheries delivered his remarks and open the workshop as in the attached document **Annex 5.**

- Opening remarks -

Next **Dr. Hav Viseth** presented on accomplishment of the project in 1st year from April 2011 to February 2012 as in the attached document **Annex 7.**

After the presentation is finished, the whole meeting is thoroughly and activity discussed with the opinions as below.

Mr. Kao Mony Rith asks

1. After the 1st phrase project ended, will the project plan to monitor or compare fish farmers' activities during project's supports and after ending project? Did fish famers still continue to culture fish or not?
2. The project has supported the Laboratory Room at Tek Vil Fish Seed Producing and Research Station, what level is the capacity of the laboratory room able to analyze water quality?
3. How is there effect to water quality for deeper digging ponds?

Dr. Hav Viseth answers

1. In the 4 provinces, we observed that after the 1st phrase project ended both fish farmers and fish seed producers still continue their fish culture activities, are active, and are also working well. They always come to meet one time per month and, in some provinces one time per two months. In other words, the fish seed producers have shared and transferred their knowledge and techniques to new fish farmers at their villages. Therefore fish seed demands at their villages are increasing from one year to year.
2. Laboratory jobs at Tek Vil Fish Seed Producing and Research Station, it is not complicated. However the staff capacity is limited, there is a project's expert, Dr. Hara; he has stayed permanently there, so that the staff can learn much from him directly.
3. Water quality in water wells, both me and JICA are always worrying about 12 meters' deeper well. The water pumping is not good quality because it is rich of iron and low pH from 5 to 5.5. Therefore the project is thinking of how we should make with the wells to ensure the water quality for fish seed producing to get successful.

Mr. Hong Hy suggests

Farmers are today lacking good brood stock so that the Teok Vil Station should be strong interested in preserving good brood stock and having quality to be distributed to fish seed producers.

Next **Dr. Hav Viseth** continued to present another topic on Work plan of the Project for 2nd year from 2012 to 2012 as in the attached document **Annex 8.**

After the presentation is finished, the whole meeting is thoroughly and activity discussed with the opinions as below.

Mr. Lieng Sopha suggest

Please, JICA also help community fisheries to enhance and improve the livelihood of people.

Then **Mr. Chin Da** presented proposed revised indicator for PDM as in the attached document **Annex 9.**

After the presentation is finished, the whole meeting is thoroughly and activity discussed with the opinions as below.

Mr. Meng Sothay asks

We set up especial indicators of 3000 fish farmers during 4 years. But later the indicator was set up per one year due to fluctuation situation like fishing lots' suspension around the Tonle Sap Great Lake to ensure richer fisheries resources. In other words, fisheries administration has issued long version to release fish into fishing grounds so that fish is now richer and the fish price is cheaper at markets. Some fish farmers stopped to do fish culture; it is not like previous time. In this case questions are raised that whether above mentioned problems cause impacts to setting of indicators for year 2014?

Dr. Hav Viseth answers

Regarding the above question issues, site and farmer selections are selected for the sites that are located far away from fishing grounds. However the Pursat, Battambang, and Siem Reap

province are closed to the Tonle Sap, we observed that national road's upper areas are strong fish deficit areas and there are the plenty of rice field fisheries during rainy season. From November to December the water of the rice field dry and some areas are also dried up, leading fish in the rice field not to survive. Therefore we can do fish culture in the period of 2-3months before rainfall. It is observed that farmers' yield of fish culture get from 35 to 40 km per $100m^2$ so that it is not effects to fish culture in these provinces if sites are select well and properly.

His Excellency Dr. Nao Thuok answers and comments

Based on the indicator per year, the selection of 5 fish seed producers per province is thinking carefully according to the indicator, I think that this is likely little and I would like to inform that some areas set up few numbers. In the past due to the plenty of fish at water body, leading fish culture was slowly. Although fish production increases, it does not meet with people's demand. Therefore it is needed to set up high indicators. For example the indicator 3-3, I think that it must be set up to 200 to 300%. As Dr. Hav Viseth's presentation showed that fish seed producers in Pursat province produced 770,000 seed in 2011, it mean that it can increase 2 to 3 millions. If it increases by 1,400,000 seed, mean that it increase by 100% so that if it increase from 2 to 3 million seed, mean that it increase 200 to 300 %. Finally I would like to suggest that fish seed producers should contribute to payments for the association to ensure that we will have money to organize a meeting continuously when JICA end the project to support.

Mr. NIWA responds

The indicator for Project purpose in PDM should be clear from now. If you just say, the English phrase "Aquaculture production" or "Production of small-scale aquaculture" what the production indicates is not clear. Amount of production includes variety types of aquaculture, and also we cannot know whether the figure means production for years or one year. It should be set clearly based on real thinks and materials. So I propose the new phrase "Annual production of small-scale aquaculture promoted by Project" is increased up to 150 tones in target area in 2015. We shall keep what I corrected in this paragraph, if there is no objection.

Mr. Bun Rasy asks

1. What methods does the project have to find out markets for fish seed producers?
2. Regarding farmers' training, we would have fisheries officers nearby farmers?
3. For Tek Vil Fish Seed Producing and Research Station, we would have to do more research on the study of hatchelling feed.

Dr. Hav Viseth answers

1. For market methods, today we are working this way, including monthly network meeting to discuss market issues and for example recommend them to make sign boards.
2. For farmers' training, we did not allow farmers to teach alone, we have Fisheries Cantonment Officers to facilitate the training.
3. Regarding research at the station, **Dr. Hara** stay there, he is planning to do a research on seed production technology and feed development.

Regarding His Excellency Director General on the indictors of increasing related to fish seed producing, it is real what I discussed with Mr. NIWA and set up to 200%, but reduced by 100% to keep the workshop interested.

Mr. Prin Sayin suggests

1. Please, the project assists to continuously provide fish seed to fish farmers flooded 1st year?
2. The project help to give plastic bag to fish farmers to nurse brood stock during dry season, please
3. The project help to share mutual experiences from farmer to farmer, please

His Excellency Mr. Srun Limsong asks

1. In the past, for flooded issue, what will the project plan to provide materials or equipments to ensure brood stock protection?
2. Regarding outside country's training, in the past we have been to Indonesia and it is a good methods, but it is far away. I think that it is better; we should go to Vietnam because it is related to fish species, weather condition, and geographical status is similar, especially both brood stock and fish seed imported and exported mutually so that study tour in Vietnam is a good , especially high technology for small scale.

Dr. Hav Viseth answers

The project is discussing these issues on how should we to solve the issues?

Mr. Meng Sothay suggests

1. Please, the project helps to change brood stock to fish seed producers?
2. Please, the project helps to dig pond in other communes for next year?
3. Please, the project helps to give water quality measurement equipment and camera

Mr. Heng Sovannara suggests and asks

1. Can the project help to support fish seed to fish farmers who have fish predators in the pond? Can the project help limes and Hapa to fish farmers?
2. Please, the project has study tour to change experiences between farmers and farmers

Dr. Hav Viseth answers

The issues raised, some issues are addressed already. For pond issues that are presence of rice field fish predators in the pond, I am discussing with Mr. NIWA, whether how we should solve these issues?

for study tour, I also want to know from Mr. NIWA because the 1st phrase project we can mobilize from one farmer to another farmer, but the 2nd phrase we just conduct a training and visit farmer 's fish seed producing farms.

Mr. NIWA responses

I think that study exchanges among fish seed producers will realized in upcoming fish seed producer's meeting that will be prepared every year from the 2nd year. This is a chance for us to share mutual study tour for fish farmers and we will organize this program in the 3rd year.

In other words, I understood that this is a main job for capacity enhancements of fish seed producers and we will prepare this work plan in the 3rd year. We will select any fish seed producer who is good character to become model farmers and invite in the meeting of fish seed producers in their target areas. However we cannot call all fish farmers to join the

meeting because it is numerous and is it is not realistic. We just select several farmers who are active, good working and have good character to be "extensionist" in each commune. And then we will invite them to join the study tour for mutual experience exchanges.

Concerning pond digging, I heard Battambang provinces that it is a good status and has influences to farmers there. Actually this program was trial that was planned only for this year, it is not sure whether the project will continue this program for next year or not. I am also worrying about the implementation of the 4 years' project because we also set the increasing number of fish farmers to train year by year. As Mr.Chinda presentated, the project plans to train 750 new farmers in 2nd year and then 1,125 new farmers in 3rd and 4th year respectively. I wonder whether there is enough number of farmers who have pond for aquaculture in our new target communes and whether we can find it every year. If there is difficulty to look for the farmers who have pond, the project should consider support program to promote for them to have the pond.

And now I would like to ask attendant from the provinces, (1) Is it possible to look for enough number of potential fish farmer, farmers who have pond in 2nd , 3rd and 4th year? (2)Is the support program for pond digging to be useful method? and Do we need to continue it? (3)Is there any alternative idea to support them to have pond? If you know well about real situation of the province, please tell it frankly and let us know.

At the end, **His Excellency Nao Thouk** expressed thank to His Excellencies ladies and gentlemen, who participated in the active discussion meeting for this whole morning, and sum up the brief results.

After that **His Excellency Mr. Por Try**, Secretary of State of the Ministry of Agriculture, Forestry and Fisheries deliver his remarks to close the meeting as in the attached document **Annex 9.**

The meeting ended at 11:30 of the same date under the highly responsible,happy and extreme friendly atmosphere.

Phnom Penh, 21st February 2012

Minute writer

Meeting chairman

Document and Record

of

The 1st Joint Coordinating Committee (JCC) Meeting

21st February (Tuesday) 2012

Annex 1	Agenda of the meeting
Annex 2	List of Participants
	Speeches
Annex 3	- Welcome Address H.E NAO Thuok,Director General, Fisheries Administration
Annex 4	- Keynote Speech Mr. Kobayashi Yukiharu, Senior Representative, JICA Cambodia Office
Annex 5	- Opening Remarks H.E POR Try , Secretary of State, MAFF
Annex 6	- Closing Remarks H.E POR Try , Secretary of State, MAFF
	Presentation
Annex 7	- Accomplishments from April 2011 to February 2012
Annex 8	- Annual Work Plan from April 2012 to March 2013
Annex 9	- Proposed indicators for Project output in Project Design Matrix (PDM)
Annex 10	Revised PDM

Annex 1

Proposed Agenda
for
The 1st Joint Coordinating Committee (JCC) Meeting

21st February (Tuesday) 2012

At the Conference Room, Fisheries Administration

08:00 – 08:30	Registration
08:30 – 09:00	Opening Ceremony Welcome Speeches - H.E NAO Thuok Director General, Fisheries Administration - Mr. Kobayashi Senior Representative, JICA Cambodia Office Opening Remarks - H.E POR Try Secretary of State, MAFF
09:00 – 09:30	Accomplishments from April 2011 to February 2012
09:30 – 10:30	Annual Work Plan from April 2012 to March 2013 Proposed indicators for Project output in Project Design Matrix (PDM)
10:30 – 10:45	Breaks
10:45 – 11:15	Plenary Discussions
11:15 – 11:30	Closing Remarks - H.E POR Try Secretary of State, MAFF

Annex 2

Kingdom of Cambodia
National Religion King

Ministry Of Agriculture Forestry and Fisheries
Fisheries Administration

List Name of Participation
February 21, 2012 at 8:30 AM

Under charman : under the presidency of His Excellency Por Try, secretary of state of the ministry of agriculture forestry and fisheries.

Meeting: **THE FIRST JOINT COORDINATING COMMITTEE MEETING**
The Freshwater Aquaculture Improvement and Extension Project 2

N.o	Name	Position	Institute	Telephone	Signature
1	H.E Por Try	Secretary of State of MAFF	MAFF		
2	Dr. Nao Thuok	Director General of FiA	FiA		
3	Dr. Hav Viseth	Director of DAD	FiA	099 567777	
4	Srun Limsong	Deputy Director General of FiA	FiA		
5	Chin Da	Deputy Director of DAD	FiA	011 980990	
6	Pel SamNang	Official staff of DAD	FiA	012 945547	
7	Kong Sokha	Deputy chief of FiA cantonment	Battambang	012 383361	
8	Leng Sovannara	Deputy chief of FiA Division Anlung Vil	Battambang	097 707282	
9	Lang Phal	official staff of FiA inspectorate of Mekong	Kampong Cham	089 677796	
10	Meng Sothai	Chief of FiA Division Outaki	Battambang	012 358565	
11	Nen Phanna	Official staff of FARDeC	Prey Veng	017 958676	
12	Hong Hy	Director of FiA Inspectorate of Khang Tboung Boeung Tonle Sab	Pursat	17735169	
13	Prin Savin	Chief of FiA cantonment	Siem Reap	012 821584	
14	Kea Poleak	Deputy chief of FiA Division Chung Khneas	Siem Reap	012 947767	
15	Uy Sovanny	Deputy chief of FiA Sangkat Bakorng	Siem Reap	012 961204	
16	Hip MorRa	Director of Fish seed production station Toek Vil	Siem Reap	012 512926	
17	Thaung Thavy	Deputy chief of Admin of MARDeC	Kampong Saum	017 376879	
18	Niwa Yukiyasu	Chief Advisor	FAIEX 2		
19	Bun Rasy	Deputy Director of Fisheries conservation	FiA	015 915567	
20	Chhay Morn	Deputy chief of FiA cantonment	Pursat	012 912531	
21	Seng Songly	Official staff of FiA cantonment Pursat	Pursat		
22	Neang Nget	Official staff of FiA cantonment Pursat	Pursat		
23	Kav Monyrith	Deputy Director of FiA Inspectorate of Sakmuth	Kampong Saum		
24	Seum Thavry	Deputy Director of IFReDI	FiA		
25	Bin Savoeun	Official staff of DAD	FiA		
26	Ros Vuthy	Deputy Director of FiA Inspectorate of Khang Chheung Boeung Tonle Sab	Kampong Thom		
27	Kong Socheat	Cameraman	Ecamici Today		
28	Sok Lak	Journalist	Journal		
29	Pol Mimosa	Official staff of DAD	FiA		

30	Prom Phaly	Deputy chief of Fish Seed Production Station 1	Kandal	012 916575	
31	Deab Leung	Deputy Director of DAAL	FiA	016 828820	
32	Yukiharu Kobayashi	Senior Representative	JICA		
33	Akie Umeno	Operate Supported	JICA	012 333069	
34	Saori Shiokawa	Supporty Staff	JICA		
35	Eung Kunthea	Official staff of DAD	FiA		
36	Leang Sopha	Acting Director of CFD	FiA		
37	Chea Tharith	Deputy Director of MaFReDI	Kampong Saum	012 467028	
38	Haing Leap	Deputy Director of DAD	FiA		
39	Song Hong	Deputy Director of FiA Inspectorate of Chaktomok	Kandal		
40	Hem Rady	Official staff of DPFIC	FiA	017 495270	
41	Hatori Tatsuya	Expert	JICA	012 222867	
42	Ouch Lang	Official staff of DAD	FiA		
43	Prak Viseth	Official staff of DAD	FiA		
44	Chhor Bunly	Official staff of DAD	FiA		
45	Sroy Seangly	Official staff of DAD	FiA		
46	Sreng Phonny	Deputy Director of DAD	FiA		
47	Sato Makoto	Coordinator	FAIEX 2		

FiA - Fisheries Administration
DAD- Department of Aquaculture Development
DAAL - Department of Administrative Affairs and Litigation
DPFIC - Department of Planning Finance and International Cooperation
DCFD - Department of Community Fisheries Development
IFReDI- Inland Fisheries Research and Development Institute
FARDeC - Freshwater Aquaculture Development and Research Center
MaFReDI - Marine Fisheries Research and Development Institute
MARDeC - Marine Aquaculture Research and Development Center

Annex 3

WELCOME ADDESS

by

His Excellency **Dr. Nao Thuok**

Delegate of the Royal Government of Cambodia in charge

of

Director General of Fisheries Administration

in

the 1st Joint Project Coordination and Cooperation Committee (JCC) Meeting

FiA, 21st February, 2012

My respect to:

- **His Excellency Por Try** : Secretary of State of the Ministry of Agriculture, Forestry and Fisheries
- **Mr. Kobayashi Yukiharu** : Senior Representative JICA in Cambodia
- **Mr. Niwa Yukiyasu** : Chief of Advisor's the Freshwater Aquaculture Improvement and Extension Project
- Mr. Deputy of Director General of Fisheries Administration
- Mr. Representative of Cambodian Development Council
- Mr. Director of Department of Inspectorate and Provincial and City Fisheries Administration Cantonment
- All participants, national and international quests

Before beginning the program, on behalf of the Fisheries Administration of the Ministry of Agriculture, Forestry, and Fisheries, I would like to express heartfelt thanks and warmly welcome to presence of his Excellency, Mr., Madam, and all national and international quests, who took valuable opportunities to attend the 1st Joint Project Coordination and Cooperation Committee meeting this time in order to evaluate the project implementation on "the Freshwater Aquaculture Improvement and Extension for 2nd Phrase" which have worked one year ago in Pursat, Battambang, and Siem Reap provinces, which is a technical cooperation between the Royal Kingdom of Japan and

Cambodia. The project was supported by Japanese Government with period of 4 years, starting its plans on 01 April 2011, and will finish on March 2015.

Whole workshop!
National and International Quests!

Many generations ago, Cambodia is a society to like eating fish in which is daily diets of people, especially farmers need it badly and cannot lack it in their livelihood, eating both fresh and processing products such as fish past "Prohok" fermented fish "Pork", fish sauce, sunny dried fish, and smoked fish etc., especially the fish past is a main ingredient of the khmer food. Cambodia was recognized that is a country which is rich of fisheries resources, especially freshwater fish. Due to climate change and population growth, fish demands increased gradually and wild fish productions cannot supply based on demands. This is a key issue in which we need to solve the issues altogether, so that extension and aquaculture development is needed and is very important in ensuring food supplies for people, especially for people living in isolate areas from fishing ground, rivers and lakes.

To address the issues, the development of aquaculture sector is paid strong attention and plays a main function in reducing fish shortage for eating, fish capture, and preserving domestic species in which are toward extinction too. This reason pushed the Fisheries Administration to set up strategy for the extension and aquaculture development that is a main factor to enhance food security. A first step is to kick off implementing in potential areas in aquaculture development, especially the areas that are isolated from fishing lot ground to solve fish shortage for eating of farmers. To ensure working developments well and effectively, therefore, it is necessary to endeavor furthermore works like the recommendations of His Excellency **Dr. Chan Sarun**, Minister of Ministry of Agriculture, Forestry, and Fisheries provided during the close of annual meeting on fisheries sector on 26 January 2007 in the past that to promote aquaculture development and fishery resources management, especially at local areas, director of department of inspectorate and director of all provincial and city fisheries

administration cantonments have to pay attentions and achieve the promotion of aquaculture development, including the establishment of fish seed production sites and community of fish refuge ponds management, one place per commune, in good collaboration with local authorities, especially with national and international organizations to support both budget and techniques to training fishery officers to get high capacity in job leading.

I hope that aquaculture development project supported by JICA, helped Cambodian people, especially famers located in the target areas of the project such as Pursat, Battambang, and Siem Reap provinces, increasing of fish for eating and income in their family too. This is a good activity in contributing to poverty reduction in accordance with Rectangular Policy of the Royal Government of Cambodia. So we have to pay attention and collaborate smoothly to ensure the project implementation running well and effectively.

On behalf of Fisheries Administration, I would like to express warmly thanks to the Royal Government of Cambodia and Japanese people as well as JICA in which strongly support the Cambodian Government, both budgets and techniques in the Freshwater Aquaculture Improvement and Extension Project for 2nd Phrase in Cambodia. The aquaculture development project improve rural people livelihood in Pursat, Battambang, and Sie Reap provinces where is a basic in the extension and expanding of aquaculture activities to other fish deficit provinces soon.

Finally I grace best wishes to His Excellency, Mr. Madam, and national and international guests to meet happiness and get successful in duties.

Annex 4

Speech of Mr.Yukiharu Kobayashi, Senior Representative, JICA Cambodia Office
At the first Joint Coordination Committee (JCC) for FAIEX-2 on 21th Feburary 2012

H.E POR Try Secretary of State, Ministry of Agriculture, Forestry and Fisheries

H.E Dr. NAO Thuok, Director General, Fisheries Administration

Excellencies, Distinguished Guests, Ladies and Gentlemen

It is my great honor and pleasure to make a welcome speech at the first joint coordination committee for Freshwater Aquaculture Improvement and Extension Project in Cambodia Phase 2, in short, FAIEX-2.

On behalf of Japan International Cooperation Agency (JICA), I would like to express my sincere appreciation for your active participation and contribution to FAIEX-2 and today's 1st Joint Coordination Committee (JCC).

FAIEX-2 commenced its activities from March, 2011 based on the Record of Discussion signed on January 10Th, 2011 between MAFF and JICA. Through the project activities for almost a year, I understood that there were unavoidable natural phenomena, such as drought and flood. Nonetheless, FAIEX-2 has made a steady progress resulting from strong effort and motivation to the Project by relevant players.

Based on the outputs from the past relevant projects, namely FAIEX-1 which was implemented at 4 southern provinces, Prey-Veng, Takeo, Kampong-Speu, and Kampot from February 2005 to February 2010, FAIEX-2 has extended its activities to Northwest provinces, Pursat, Battambang, and Siem Reap province. I sincerely hope that today's JCC will disseminate not only the achievements and lessons learnt but also constraint and challenges which shall be shared and discussed among today's

participants.

Freshwater fisheries are one of the most important aquatic recourses in Cambodia. FAIEX1 and 2 have supported small-scale aquaculture by farmer to farmer extension method to improve knowledge and techniques on fish culture. And the projects also supported fish seed production technology for the extension of freshwater aquaculture. Improvement of aquaculture techniques is obviously important, however, I also would like to put an emphasis on the coordination and collaboration, between FAIEX-2 project and MAFF Today, as we have attendance of the representatives from MAFF, I expect that valuable suggestion will be provided in the discussion session.

JICA always respects the ownership of the Royal Government of Cambodia and works in partnership to support the effort of Royal Government of Cambodia to contribute the development of social and economic situation by her own. I hope you all understand the significance and the implication of this Project and expect your further commitment to the Project.

Once again, I would like to express my sincere appreciation for your active participation in today's JCC. I wish today's meeting generate fruitful, constructive and tangible suggestions to the Project.

Thank you very much for your kind attention.

End

Annex 5

OPENING REMARKS

by

His Excellency Por Try

Secretary of State of the Ministry of Agriculture, Forestry and Fisheries

in

the 1st Joint Project Coordination and Cooperation Committee (JCC) Meeting

FiA, 21st February, 2012

My respect to:

- His Excellency **Dr. Nao Thuok** : Delegate of the Royal Government of Cambodia in charge of Director General of Fisheries Administration
- **Mr. Kobayashi Yukiharu** : Senior Representative JICA in Cambodia
- **Mr. Niwa Yukiyasu** : Chief of Advisor's the Freshwater Aquaculture Improvement and Extension Project
- Mr. Deputy of Director General of Fisheries Administration
- Mr. Representative of Cambodian Development Council
- Mr. Director of Department of Inspectorate and Provincial and City Fisheries Administration Cantonment
- All participants, national and international quests

On behalf of the Ministry of agriculture, Forestry and Fisheries, I am very pleased to take part in His Excellency, Mr., Madam, and national and international guests in the 1st Joint Project Coordination and Cooperation Committee meeting on "the Freshwater Aquaculture Improvement and Extension Project for 2nd Phrase" this time. The purpose of the meeting today is to monitor and evaluate the achievement outputs for 1 year ago as well as indicators for continuous implementation plans for 3 years until 2015 of the project, and to enter experiences and improve inactivity to reach high effective implementations.

The Freshwater Aquaculture Improvement and Extension Project for 2nd Phrase is a continuous project from 1st phrase in which implemented successfully in Kampong speu, Takeo, Kampot, and Prey Veng provinces from February 2005 to February 2010, with period of 5 years. Due to success in the 1st phrase, the Japanese Government decided to resume supports of the project for 4 years onward, starting the implementation of activities from March 2011 and will end the activities by March 2015 in 3 new target provinces such as Pursat, Battambang, and Siem reap provinces. The

success of 1st phrase project is due to endeavoring job implementations altogether and strongly supports from the Ministry of Agriculture, Forestry, and Fisheries. Therefore well have to continue the efforts of 2nd Phrase Project's implementation to get successful like the 1st Phrase, to be a pride for the Fisheries Administration like the Ministry of Agriculture, Forestry, and Fisheries, and collect good experiences from the 1st Phrase to implement continuously, and to find out good methods for the 2nd Phrase project implementation to get successful. The project is the royal government project which has its objective to help rural people livelihood improvement of Cambodia through integrations of aquaculture activities such as teaching farmers to do fish culture and fish seed producing.

Today is a best chance for us to contribute and provide good versions and ideas to discussions on the project plans for year 2012 and indicators for continuous implementation plans for 3 years until 2015 of the project to ensure the achievements of project objectives. Therefore, participations of His Excellency, Mr., and Madam showed that there are high attempts in the promotion and aquaculture development in order to increasing aquaculture yields in Cambodia in term of increasing in protein level and income of rural poor people.

Coming soon, it is informed well about the achievement outputs of one year's project ago and indicators for continuous implementation plans for 3 years until 2015 of the project in the 3 target provinces of the project such as Pursat, Battambangm, and Siem Reap provinces. I strongly hope that the aquaculture development project supported by JICA has really assisted to increase fish for eating to Cambodia people and incomes in their family in order to contribute to poverty reduction of rural people in accordance with the Rectangular Policy of the Royal Government of Cambodia. Therefore we have to pay attentions and collaborated smoothly to gear up aquaculture activities better and effectively.

On behalf of the Ministry of Agriculture, Forestry, and Fisheries, I would like to express heartfelt thanks to the Royal Government of Japanese and JICA in which support both budgets and techniques to the Cambodian Government to develop freshwater aquaculture sector in Cambodia. I feel confident that the project has really helped to improve rural poor people livelihood in Pursat, Battambang, and Sie Reap provinces and has been extended and expanded aquaculture activities to other provinces of every areas in order to enhance rural poor people livelihood.

Finally I grace best wishes to His Excellency, Mr. Madam, and national and international guests to meet happiness and get successful in duties, and open the workshop this time.

Annex 6

CLOSING REMARKS

by

His Excellency Por Try

Secretary of State of the Ministry of Agriculture, Forestry and Fisheries

in

the 1st Joint Project Coordination and Cooperation Committee (JCC) Meeting

FiA, 21st February, 2012

His Excellency,
All participants, national and international guests,
Residence Representative of JICA in Cambodia!

On behalf of the Ministry of agriculture, Forestry and Fisheries, I express warmly thanks to His Excellency, Mr., Madam, and national and international guests who took valuable opportunities to participate in the workshop on "the achievement outputs for 2011 and continuous plan implementation for 2012 of the project on the Freshwater Aquaculture Improvement and Extension Project for 2nd Phase". The project has really improved management jobs and aquaculture development technique, with scientific condition in order to ensure that aquaculture activities are growing effectively and sustainably. I would express delighted feeling and congratulation to the results of the workshop this time. Even though the workshop has short time, mid-day only, all participants endeavored to give ideas and opinions heartedly and confidently, closely, and have a high responsible spirit

The whole workshop!

I observed that all ideas and opinions of the workshop raised are suitable and proper to current situation of Cambodia. The Royal Government took economic policy to solve food security, reduce the poverty of rural poor people, and to ensure sustainable natural resource sources, both in water and land. Aquaculture development plays a main role in fulfilling food demand for people while fisheries capture is fluctuating and then the number of people is growing from day to day, this cannot respond to increasing demand of food.

Current aquaculture activities are growing; making people participated in fish culture remarkably from year to year. This is due to attention from the Ministry of Agriculture, Forestry, and Fisheries and strong supports from Fisheries Administration concerning

leading, management, and direct implementation of the Freshwater Aquaculture Improvement and Extension Project for 2nd Phrase and other aquaculture development project. Actually, one year ago, there are more than 500 new farmers participating in fish culture in Pursat, Battambang, and Siem Reap provinces. Out of 14 farmers were also trained to become fish seed producers. The project trained those farmers to become principle trainers in order to train other fish farmers. Moreover the project helps and supports Toek Vil Research and Fish Seed Producing Station in research study in aquaculture techniques. The results from the research will be disseminated to other fish farmers. In other words, the project also pays attention in helping existing fish refuge pond development at local in order to preserve and protect brood stock, and increase fish stock in the refuge pond. Based on aquaculture development actions, I feel confident that aquaculture sector will speed up from year to year through the project's extension and fish seed producers.

I would like to take this opportunity to express congratulations to the results of project that was done in the past. However the project meets difficulties, this is lesson learned for us to address next year. I would agree and support the plans for continuous project implement of the Freshwater Aquaculture Improvement and Extension Project for 2nd Phrase. To achieve these plans, it is needed to participate and collaborate well from all parties in the Joint Project Coordination and Cooperation Committee, with government fish stations, private group's aquaculturists, fish refuge pond community, and involving national and international organizations, and to attend research studies and extensions on fish culture and fish seed producing techniques, and sustainable fisheries resource management at local. I strongly believe that the discussions in the workshop are a key to solve well and reach toward success in the future.

I would express thanks to His Excellency, Mr. Madam, and national and international guests who spend valuable times in joining the workshop and get fruitful

Finally I grace best wishes to His Excellency, Mr. Madam, and national and international guests to meet happiness and get successful in duties, and close the workshop this time.

ACCOMPLISHMENTS

of

Fresh Aquaculture Improvement and Extension Project II (FAIEX-2) in Cambodia

April 2011 - February 2012

21 February, 2012

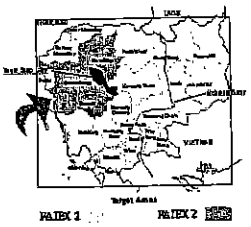
The 1st Joint Coordinating Committee (JCC) Meeting

Introduction

- After successful of implementation of FAIEX-1 (2005-2010)
- FAIEX-2 launched to promote fish culture for small-scale farmers

(April 2011-March 2015)

- Pursat
- Battambang
- Siem Reap



Overall Goal

Household economy of small-scale fish farmers are improved in the target provinces.

Project Purpose

Small-scale aquaculture production is increased in the target provinces.

Expected Output

- Small-scale seed production and grow-out technology is improved.
- Capacity of local aquaculture extension services is enhanced.
- Fish seed farmers are capacitated.
- Small scale aquaculture is expanded in the target provinces.
- Networks of fish seed farmers are enhanced and broadened.

Personnel

Cambodian side: 24

- Fisheries Administration: 8
- Fisheries Administration Cantonment: 16

Japanese side

Experts in the fields of:

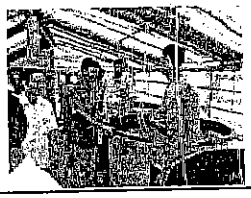
- Chief Adviser / Extension Administration
- Aquaculture Extension
- Coordinator / Rural Development
- Broodstock Management / Seed Production
- Community Fish Refuge

Results of the1st Year's Implementation

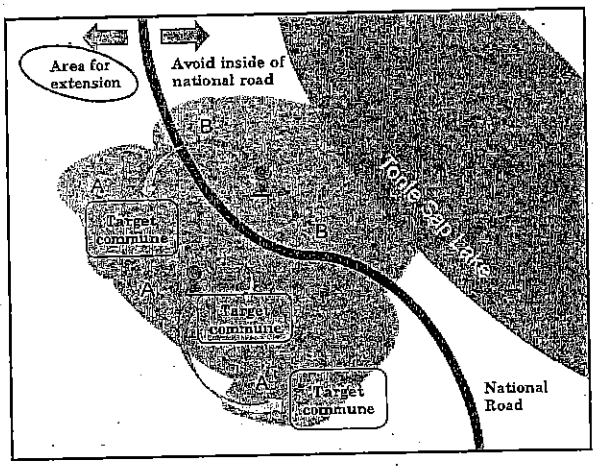
Capacity development for local extension officers

Training course on Aquaculture Technologies and Extension Methods

- Date: April 20-28, 2011
- Participant: 22 local extension officers and technical staffs
- Place: Fish seed farmer's house in Takeo



Selection of Target Communes & Fish Farmers



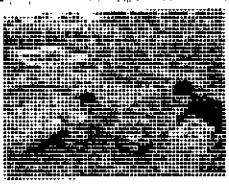
Fish Seed Farmers

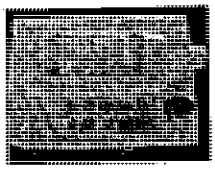
- 14 existing fish seed farmers selected (1st year seed farmer)
  - Pursat: 4 farmers
  - Battambang: 6 farmers
  - Siem Reap: 4 farmers

- Training for aquaculture technical improvement was organized
  - Date: 5-11 May, 2011 (7 days)
  - Place: Seed farmer in Takeo
  - Participant: 25 farmers from 3 target provinces + Ratanakiry province

Provision of Materials for Hatchery Operation

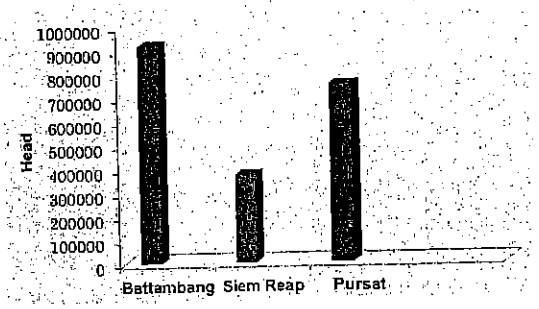
- Construction materials
- Water pump
- Hatching jar
- Hormone
- Net
- Brood fish
- pH meter





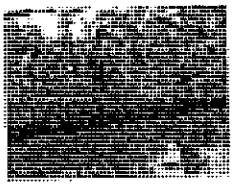
Number of Fish Seed Produced, 2011

(14 seed producing farmers)



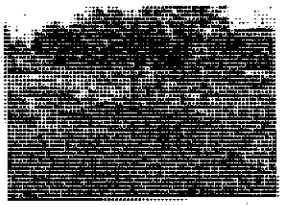
Fish Farmers

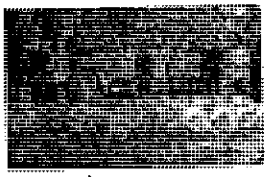
- 505 farmers selected from 19 target communes in 3 provinces
- Training on fish culture provided
- 2 days/course (from June 15-28)
- Technical advice (Follow-up)



Distribution of fish seed & Material

- 231,500 fingerlings distributed to fish farmers in 3 provinces
- 500 fingerlings / farmer
- 1 hapa/farmer





Selection of New Fish Seed Farmers in Preparation for 2nd Year's Seed Production

- 16 fish seed farmers selected (2nd year seed farmer)
  - Pursat: 5 farmers
  - Battambang: 5 farmers
  - Siem Reap: 6 farmers

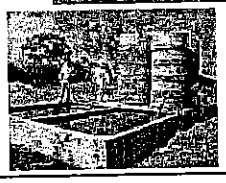
Fish Seed Production Training (2 courses)

(1)Place: Battambang province
- Date: October 11-14, 2011
- 10 farmer participants

(2) Place: Takeo province
- Date: November 21-26, 2011
- 16 farmer participants

Provision of Hatchery Materials

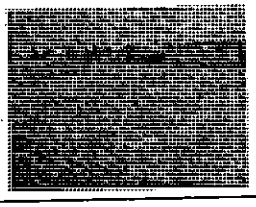
- Construction materials
- Provision of inputs (Brooders, hormone, hapa nets)
- Technical advice on hatchery development and operation



Support to House's Hold Pond Digging

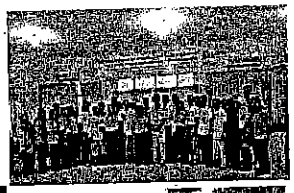
- Pursat: 45 ponds
- Battambang: 45 ponds
- Siem Reap: 45 ponds

(Size: 10m x 15m x 2m)



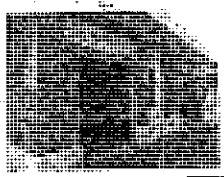
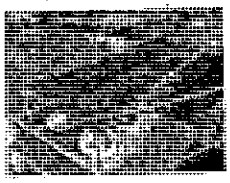
Training Course on Aquaculture in Indonesia

- From October 2-21, 2011
- Participant: 11 persons (FiA : 4, FiA cantonment :3, Farmer : 4)



Support to Rehabilitation of Toekvil Aquaculture Station

- **Building renovation work**
  - Laboratory Bld
  - Wet laboratory
  - Office Bld
  - Feed Kitchen
  - Hatchery

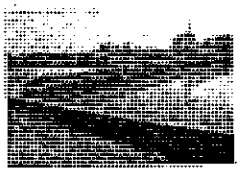



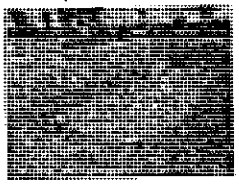

Rehabilitation of Toekvil




Rehabilitation of Toekvil

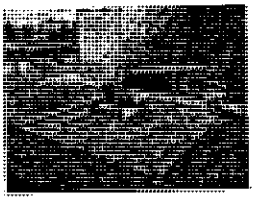
- **Pond renovation**
  - Pond renovation
  - Brick wall enclosure
  - Repair water intake piping





Rehabilitation of Toekvil

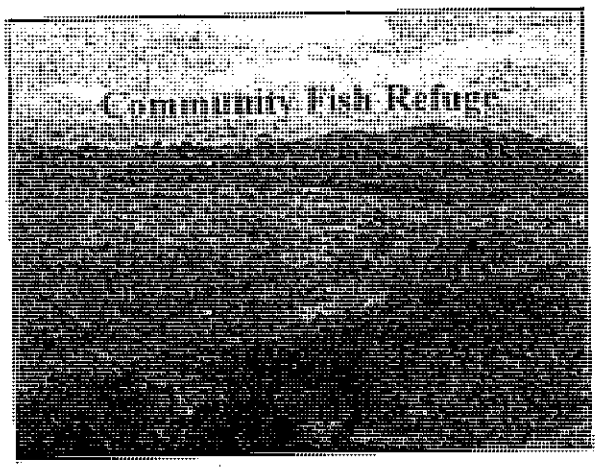
- **Mechanical & Electrical work**
  - Deep well
  - Water supply piping system



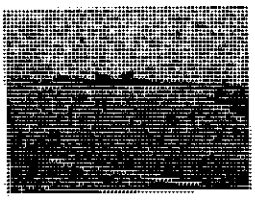

Annex 7 (JCC Presentation 1)

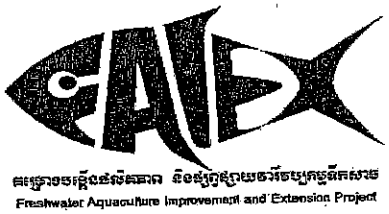
Series of Extension Material Produced and Distributed

- Fish culture techniques booklet: 3,000 copies
- Fish seed production booklet: 2,000 copies
- Aquaculture flip chart : 50 sets
- VCD of fish culture techniques: 2000 copies
- VCD of fish seed production techniques: 1000 copies
- Aquaculture calendar 2012: 2000 copies



- 4 CFRs model site selected
- Workshop was organized in each site
- Study tour to CFRs in Takeo and Kompong Speu province was organized





Thank you

Fresh Aquaculture Improvement and Extension Project II (FAIEX-2) in Cambodia

Work Plan for the 2nd year

April 2012-March 2013

21 February, 2012

The 1st Joint Coordinating Committee (JCC) Meeting

Bring up seed farmers for 2nd year

- Implement TOT to strengthen capacities for training implementation
- Support the seed production practice through on-farm guidance

Training for extension officers in Cantonment

- For local extension officers engaged in extension activities to learn basic skills of aquaculture and variety method of extension.

Implementation of Farmer to Farmer Training

- Selection of target commune
- Selection of target farmers
- Support to training participants (donate fish fingerling to new fish farmers)

Support fish farmers who suffered flooding

- Support farmers who started fish culture in 1st year of the project and suffered flooding in 2011.
- Provide necessary items such a fish fingering to encourage them to retry fish culture.

Technical improvement for small-scale aquaculture practice

- Conduct verification trials at seed farmers and small-scale fish farmers.
- Conduct technical improvement at the Toek Vil Fish Seed Production Station.

Prepare extension guideline

- Analyze extension activities undertaken, and draw up an extension guideline and good practices.

Support of CFRs management group

- Support CFR activities and prepare the CFR implementation manual.
- Monitoring of activities in CFRs by local extension officers

Support Networking of seed farmers

- Support for seed farmers to organize networking.
- Hold the network meeting at least once a year in 3 target provinces respectively.

Conduct 3rd country training

- Project will conduct 3rd country training in neighboring country targeting extension officers and seed farmers to advance their skill. (The country is not determined yet)

Follow-up on rehabilitation of Taek vil

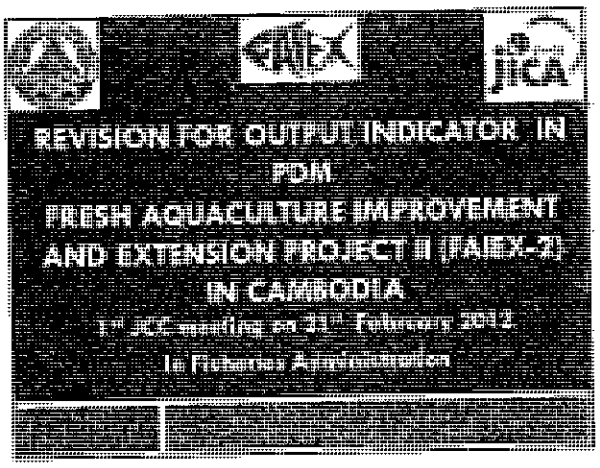
- Inspect the facilities that have been rehabilitated in previous fiscal year. (If there are some problems, detect and solve it)

Bring up new seed farmers

(Preparation for the 3rd year)

- Select seed producers for 3rd year
- Preliminary training
- Provision of necessary equipment/material for hatchery operation

Thank You Very Much



Indicator for Overall Goal

- Current Indicator:
  - The number of small-scale fish farmers with increased profits*1 and savings*2 from fish farming is increased from XX households to XX households in each target province by 2018.
- Proposed Indicator:
  - The number of small-scale fish farmers with increased profits*1 and savings*2 from fish farming is increased by 5,000 households in target areas by 2018.

Indicator for Project Purpose

Estimated aquaculture production of small-scale farm by 2015

Number of small-scale farmer	% of farmers continuing fish culture	Supposed pond size	Productivity (kg/100m2)	Aquaculture production by small-scale farmer
3,375 ×	80% ×	120 m2 ×	35 kg/100m2	= 113 ton
3,375 ×	80% ×	120 m2 ×	40 kg/100m2	= 130 ton
3,375 ×	80% ×	150 m2	35 kg/100m2	= 142 ton
3,375 ×	80% ×	150 m2	40 kg/100m2	= 162 ton

Indicator for Project Purpose

- Current Indicator:
  - Aquaculture production in each target province is increased by XX% on annual average.
- Proposed Indicator:
  - Production of small-scale aquaculture promoted by the Project is increased by 150 tons in the target areas by 2015.

Indicator for Output 1

(Small-scale seed production and grow-out technology is improved)

1.1-The number of the technical improvements through experiments is increased.

1.2-The degree of the technical improvement, such as growth rate and survival rate, is improved.

Indicator for Output 2

(Capacity of local aquaculture extension services is enhanced.)

- Current Indicator:
  - The percentage of the local extension staff who properly conducts extension activities on grow-out and seed production technology attains to more than XX% on average.
- Proposed Indicator
  - The percentage of the local extension staff who properly conducts extension activities on grow-out and seed production technology attains to more than 30% on average.

Indicator for Output 2 (cont)

(Capacity of local aquaculture extension services is enhanced.)

- Current Indicator:
  - Satisfaction ratings of the seed farmers attain to more than XX% on average regarding the teaching capability of local extension staff.
- Proposed Indicator:
  - Satisfaction ratings of the seed farmers attain to more than 80% on average regarding the teaching capability of local extension staff.

Indicator for Output 3

(Seed farmers are capacitated.)

3.1

- Current Indicator:
  - The number of seed farmers enable to produce fingerlings is increased from XX farmers to XX farmers in each target province.
- Proposed Indicator:
  - . The number of seed farmers enable to produce fingerlings is increased from19 farmers to 45 farmers in target areas.

Indicator for Output 3 (cont)

(Seed farmers are capacitated.)

3.2

- Current Indicator:
  - The number of seed farmers who can produce seed of at least three species is increased by XX % in each target province.
- Proposed Indicator:
  - The number of seed farmers who can produce seed of at least three species is increased by 100 % in target areas.

Indicator for Output 3 (cont)

(Seed farmers are capacitated.)

3.3

- Current Indicator:
  - Seed production in each target province is increased by XX%.
- Proposed Indicator:
  - Seed production in target areas is increased by 100%.

Indicator for Output 3 (cont)

(Seed farmers are capacitated.)

3.4

- Current Indicator:
  - Sales income of seed farmers is increased by XX% in each target province.
- Proposed Indicator:
  - Sales income of seed farmers is increased by 100% in target areas.

Indicator for Output 4

(Small-scale aquaculture is expanded in the target provinces.)

Target figure in FAIEX 2

1. Number of seed farmers

Province	Number of seed farmers that will be trained				
	1st year	2nd	3rd	4th	Total
Siem Reap	5	5	5	-	15
Battanbang	5	5	5	-	15
Pursat	5	5	5	-	15
Total	15	15	15	0	45
Add up	15	30	45	45	

2. Number of grow-out farmer who will be trained by FFT

conduct training25 grow-out farmers on average at least in one target commune

Traget number of trained grow-out farmer of the year	375	750	1125	1125	
Add up	375	1,125	2,250	3,375	3,375

Indicator for Output 4

(Small-scale aquaculture is expanded in the target provinces.)

- Current Indicator:
  - The number of small-scale fish farmers benefitted from farmer-to-farmer training attains to more than XX households in the target provinces.
- Proposed Indicator:
  - The number of small-scale fish farmers benefitted from farmer-to-farmer training attains to more than 3,000 households in target areas.

Indicator for Output 4 (cont)

(Small-scale aquaculture is expanded in the target provinces.)

- Current Indicator:
  - The number of small-scale fish farmers working for community fish refuges (CFRs) is increased from XX households to XX households in each target province.
- Proposed Indicator:
  - The number of small-scale farmers utilizing proper CFR implementation method (or managing CFR properly) is increased up to 30 households in target areas.

Indicator for Output 5

(Networks of seed formers are enhanced and broadened.)

- Current Indicator:
  - The meetings for information exchange on seed production technology, seed marketing, etc. are convened XX times per year.
- Proposed Indicator:
  - The meetings for information exchange on seed production technology, seed marketing, etc. are convened 2 times per year.

sUmGrKuN

THANKS SO MUCH

Annex 10 : Project Design Matrix (PDM_1)

Project Title : Freshwater Aquaculture Improvement and Extension Project II (FAIEX-2) in Cambodia
Project Period : March, 2011 – February, 2015 (Four Years)
Version No. 1
Target Areas : Pursat, Battambang, and Siem Reap Provinces
Date : February 21, 2012
Target Group : Small-scale fish farmers and seed farmers in the target areas

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Household economy of small-scale fish farmers are improved in the target provinces.	1. The number of small-scale fish farmers with increased profits*1 and savings*2 from fish farming is increased by 5,000 households in target areas by 2018.	1-1. Sampling survey/ Data from the FiA cantonment offices 1-2. Baseline/ Impact survey report	The policy and direction on the aquaculture programs are not drastically changed by the government of Cambodia.
Project Purpose Small-scale aquaculture production is increased in the target provinces.	1. Annual production of small-scale aquaculture promoted by the Project is increased up to 150 tons in target areas in 2015.	1. Baseline/ Impact survey report	Prices of cultured fishes are not largely declined.
Outputs 1. Small-scale seed production and grow-out technology is improved.	1-1. The number of the technical improvements through experiments is increased. 1-2. The degree of the technical improvement, such as growth rate and survival rate, is improved.	1-1. Technical manuals 1-2. Results of verification trials	1. Natural disasters, such as droughts, floods, etc., do not give a profound effect to the project activities.
2. Capacity of local aquaculture extension services is enhanced.	2-1. The percentage of the local extension staff who properly conducts extension activities on grow-out and seed production technology attains to more than 30% on average. 2-2. Satisfaction ratings of the seed farmers attain to more than 80% on average regarding the teaching capability of local extension staff.	2-1. Questionnaire survey to local extension staff 2-2. Questionnaire survey to seed farmers	2. Outbreaks of serious fish diseases do not occur.
3. Seed farmers are capacitated.	3-1. The number of seed farmers enable to produce fingerlings is increased from 19 farmers to 45 farmers in target areas. 3-2. The number of seed farmers who can produce seed of at least three species is increased by 200 % in target areas. 3-3. Seed production in target areas is increased by 200%. 3-4. Sales income of seed farmers is increased by 200% in target areas.	3-1. Baseline/ Impact survey report 3-2. Baseline/ Impact survey report 3-3. Baseline/ Impact survey report 3-4. Baseline/ Impact survey report	3. The imports of fingerlings from neighboring countries do not give an enormous influence to the supply balance of fingerlings produced in Cambodia.
4. Small-scale aquaculture is expanded in the target provinces.	4-1. The number of small-scale fish farmers benefitted from farmer-to-farmer training attains to more than 3,000 households in target areas. 4-2. The number of small-scale farmers managing community fish refuges (CFRs) properly is increased up to 30 households in target areas.	4-1. Baseline/ Impact survey report 4-2. Baseline/ Impact survey report	
5. Networks of seed farmers are enhanced and broadened.	5-1. The meetings for information exchange on seed production technology, seed marketing, etc. are convened 2 times per year. 5-2. The number of advices and recommendations regarding seed production technology, seed marketing, procurement of farm inputs, etc. is increased in target areas.	5-1. Records of the meetings for information exchange 5-2. Monitoring results by the Project and impact survey report	

*1 "Profit" is given by subtracting "production cost" from "fish sales income of cultured fish."
*2 "Saving" is given by self-consumption of cultured fish, which would otherwise be expenses for purchase of fish in the market, i.e., by subtracting "present cost to purchase fish" from "previous cost to purchase fish."

Activities

0 Conduct the baseline and impact surveys.

1-1 Clarify issues and challenges on small-scale seed production and grow-out technology in the target provinces.
1-2 Conduct technical improvement at the Toek Vil Fish Seed Production Station.
1-3 Conduct verification trials at seed farmers and small-scale fish farmers.
1-4 Develop technical manuals adaptive to the target provinces by revising the FAIEX-1 manuals.

2-1 Confirm and clarify roles and functions of local extension staff at each level of FiA (Cantonment, Division, and Sangkat) and local authorities.
2-2 Conduct training on grow-out technology and extension methods for local extension staff.
2-3 Conduct training on seed production technology and extension methods for selected local extension staff.
2-4 Analyze extension activities undertaken, and draw up an extension guideline and good practices.

3-1 Select target communes and seed farmers based on the criteria established.
3-2 Conduct training on seed production aspects for the seed farmers.
3-3 Assist the seed farmers in their seed production activities mainly at initial stage.

4-1 Conduct training of trainers (TOT) on grow-out technology for the seed farmers.
4-2 Assist seed farmers to conduct farmer-to-farmer training for small-scale fish farmers.
4-3 Select Community Fish Refuges (CFRs) for resource enhancement based on the criteria established.
4-4 Support CFR activities and prepare the CFR implementation manual.
4-5 Disseminate information of small-scale aquaculture among farmers and local extension staff in the target provinces.

5-1 Facilitate seed farmers to establish a provincial network to strengthen cooperation among seed farmers in each target province.
5-2 Facilitate inter-networks in the target provinces.
5-3 Promote cooperation among the networks of FAIEX-2 and FAIEX-1.

Inputs

Japanese side

1. Experts
   Chief Advisor / Aquaculture Extension
   Project Coordinator / Aquaculture Training
   Seed Production Technology
   Broodstock Development and Management
   Grow-out Technology
   Feed Development
   Fish Stock Enhancement (CFR)
   Aquaculture Facility Improvement
   Others as necessary

2. Training of counterpart personnel in Japan and/or the Third Countries

3. In-country training

4. Facility improvement of the Toek Vil Fish Seed Production Station

5. Provision of machinery and equipment
   Provision of machinery and equipment including transportation means if necessary necessary for the project activities, such as technical improvement at the Toek Vil Fish Seed Production Station, hatchery development for seed farmers, training, extension activities, etc.

6. Local expenses for the project activities
   - Expenses for workshops, seminars, etc.
   - Teaching materials for training
   - Others

Cambodian side

1. Personnel
   Project Director
   Project Manager
   Deputy Project Manager
   Counterparts

2. Provision of the project offices and facilities necessary for the project implementation

3. Expenses for the construction and development of aquaculture ponds

4. Others
   Administrative and operational expenses
   Running costs for electricity, water, etc.

The local extension staff, seed farmers, and small-scale fish farmers trained by the Project continue working for their respective positions in the target provinces.

Pre-condition

Understanding and cooperation on the project activities are obtained from famers in the target provinces.

THE MINUTE OF THE SECOND JOINT COORDINATING COMMITTEE MEETING CONCERNING THE JAPANESE TECHNICAL COOPERATION FOR THE FRESHWATER AQUACULTURE IMPROVEMENT AND EXTENSION PROJECT PHASE 2 (FAIEX-2) IN KINGDOM OF CAMBODIA

In accordance with articles of the Record of Discussions (hereinafter referred to as "the R/D") signed on January 10, 2011, Cambodia authorities concerned and the Project decided to hold the second Joint Coordinating Committee Meeting (hereinafter referred to as "the Meeting") on February 13, 2013.

During the Meeting, accomplishment from April 2012 to February 2013, work plan from April 2013 to March 2014, and mid-term evaluation report were presented as the agenda of the Meeting.

Attendants of this meeting exchanged views and discussed in respect of necessary measures to be taken by both Cambodia and Japanese sides for further successful implementation of the Project.

The both sides of attendants concerned the Project agreed to recommend to their respective Governments the matters referred to in the document.

Phnom Penh, February 13, 2013

Mr. TAKEUCHI Hiroshi

Deputy Resident Representative
Japan International Cooperation Agency Cambodia Office

Prof. Dr. Nao Thuok

Delegate of the Royal Government of Cambodia
Director General, Fisheries Administration, Ministry of Agriculture, Forestry and Fisheries

Project Director
The Freshwater Aquaculture Improvement and Extension Project Phase 2 in Cambodia

The MINUTES

of

The Second Joint Coordinating Committee Meeting on

"Achievement of Year 2012, Work Plan for Year 2013,

and Mid-Termed Evaluation Report

of

Freshwater Aquaculture Improvement and Extension Project, Phrase II"

13th February, 2013

On February 13, 2013 at 8:30 am at the Inland Fisheries Research and Development Institute, there is the 2nd Joint Coordinating Committee Meeting of the Freshwater Aquaculture Improvement and Extension Project Phrase II", that is under presidency of His Excellency Por Try, Secretary of State of the Ministry of Agriculture, Forestry and Fisheries.

List of participants is attached in Annex 2:

At the beginning, **Mr. Chin Da**, Deputy Director of Department of Aquaculture Development of the Fisheries Administration announced the meeting agenda and highlighted the objectives of the meeting as annual meeting to show the achievement of project activities implemented in three target provinces, Pursat, Battambang and Siem Reap. Then, the implementation plan scheduled for the year 2013 was highlighted to share among all participants.

Next, **Prof. Dr. Nao Thuok**, Delegate of the Royal Government of Cambodia, Director of Fisheries Administration, delivered his welcome remark to the whole meeting as in attached document **Annex 3.**

- Welcome address -

Mr. Hiroshi Izaki, Chief Representative, JICA Cambodia Office stated his remark as in the attached document Annex 4.

- Keynote speech-

After that **His Excellency Por Try**, Secretary of State of the Ministry of Agriculture, Forestry, and Fisheries delivered his remarks and open the meeting as in the attached document Annex 5.

Next **Dr. Hav Viseth** gave a presentation on Accomplishments from April 2012 to February 2013.

After the presentation, the results of evaluation including recommendation for the project activities were reported by the mid-term evaluation team. Afterward, proposed indicators of project outputs in Project Design Matrix (PDM) was presented by **Mr. Chin Da**. Consequently, there was no objection from any attendants to all contents presented by the evaluation team, such as results of evaluation / recommendation for the project activities in remained period of the project.

After that, **Dr. Hav Viseth** gave his last presentation of Annual Work Plan from April 2013 to March 2014.

After all presentations finished, all agenda and topics were discussed as mentioned below.

Questions and Answers

Mr. Kao Monirith, Deputy Director of Fisheries Administration Inspectorate of Kampong Som province asked:

1. In general, the project selected three types of fish farmers, seed producers, grow-out farmers and voluntary fish farmers, as project beneficiaries. My question is which condition or criteria the project used to select these farmers.
2. Has the project understand the present condition how fish famers participated in the project activities and how they think to continue fish culture after the completion of the project?
3. Does Dr. Hav Viseth recognize any differences of farmers' livelihoods between before and after project implementation?

Dr. Hav Viseth answered:

Thanks for Mr. Rith to raise the questions. Firstly, I want to answer the question 3 whether there are any change of farmers' livelihoods between before and after the project. In fact, there has been a remarkable change of famers' livelihoods in last two years. The farmers' representatives who attend this meeting from three target provinces, can clearly show these differences. Through the monitoring surveys conducted by the project, we found out the remarkable improvement of their economic situation, especially, for seed producers. They can be to earn good profits by selling fish seeds.

Grow-out farmers can also earn good profit from fish culture. In my observation, most of new grow-out farmers couldn't take fresh fish before the project; however, they can harvest enough fish for their home consumption. The farmers are very satisfied with these changes.

Moreover, we found a large change in seed producers. Most seed producers started seed

production in only 2 to 3 nursery ponds in the first year, then increased the number of nursery ponds in the second year. Some seed producers increased up to 10 ponds. It means that seed producers are strongly interested in fish seed production, and they clearly understand the importance of supply of fish seeds. The question 2 and 3 were covered by the explanations that I have already mentioned.

About question 1, in fact, the project pays high attention to selecting the beneficiaries, in order to avoid any problems. Because the project collaborates with three cantonment offices of Fisheries Administration, our selection policy is carefully arranged, and different from other international organizations and local NGOs.

Firstly, we targets at fish shortage areas as our project sites. We have never selected fish abundant areas like the communes where farmers can catch fish easily by fishing. Secondly, we select farmers who express their intention of fish culture.

We carefully check their intention of fish culture. For example, we planned to select more than 200 grow-out farmers in a target province; but actually we could selected only 150 to 170 farmers. We reduced them by 30 to 50 farmers, even though the number of selected farmers did not reach the target. If the farmers could not decide clearly to participate the project activity, we did not select them.

We also take a similar process to select seed producers in order to avoid selecting unqualified candidate farmers. For example, we check not only their experiences in fish grow-out culture, but also the agreements, willingness to contribution of their families for extension activities. We also check their economic situations, whether they have enough capital, labor and land to make nursery ponds or hatcheries for seed production. In conclusion, we take the selection of high quality farmers into consideration.

Mr. Meng Sothai, extension officer in Battambang province asked:

In terms of question 2, based on my two years' experience in the project, I would like to share how we know the intention of local farmers, whether they really want to culture fish or not. In general, it is not easy to know how they think of fish culture. However, we can confirm their intention by field visits and interviews. For instance, we observe the progress of their preparation for fish culture, after giving them certain technical guidance. We can evaluate their living condition, motivation, and self-effort. If local farmers start fish culture activities on our technical guidance, such as cleaning grasses around fish ponds and preparing other necessary works. It means that they clearly intend to work with the project.

Mr. Bun Rasy, Deputy Director of Department of Fisheries Conservation asked:

I request JICA to hold training courses on feed formulation and management, because the level of technical skill and knowledge of this subject in seed production is still low. We have to try to make an effort to respond this demand. I also suggest JICA to support broodstock production and management.

H.E Por Try asked:

I have been involved in the project since FAIEX-1, which targeted at four provinces and made outstanding results. I would like to draw your attention to what you have FAIEX-2 at present, because we could conduct the FAIEX-1 well.

In terms of the importance of livelihood improvement of rural households through promotion of fish culture activities, on the name of members of the Royal Government of Cambodia, I always consider making a close cooperation with JICA. It is the reason why FAIEX-2 was proposed and is implemented.

In addition, I would like to ask the persons, who are involved in the project at three provinces, for their dedication and contribution to the project activities, despite they have much constraints or difficulties compared to FAIEX-1. If FAIEX-2 will be able to deliver good outputs as FAIEX-1, we will propose FAIEX-3 for the future probably.

Dr. Hav Viseth answered:

Based on my experience in FAIEX-1, there were better conditions at target project sites, such as Prey Veng, Kampong Speu, Kampot and Takeo, when FAIEX-1 started, because aquaculture activities had been started there since 1990's.

On the other hand, aquaculture activities have just started in 2000's, in Pursat, Battambang and Siem Reap provinces. Because these three provinces are located around the Tonle Sap Great Lake, local people used to catch fish in natural waters. In spite of it, why FAIEX-2 still targets at these three provinces? In fact, our targeted communes are located in upper parts of the National Road no.5. Because selected communes are located at highland areas, they have limited condition to catch natural fish. Generally, there is less number of ponds there, and fish culture is new to most local farmers. It is not easy to make them start fish culture activities.

We have two more years for the implementation of the project. The project has achieved a plenty of accomplishments, based on the mid-term evaluation report. Moreover, we also expect that we will make better achievements than those in last two years.

I would like to express my appreciation to our counterparts of respective provinces. In addition, we got precious advices and suggestion from Japanese experts to conduct the project activities for support to local farmers, such as selection of grow-out farmers and seed producers. The JICA office asks why Fisheries Administration officers can be much engaged in project activities as their duties, compared with agricultural officers, who are also engaged in JICA projects. Some experts of other projects also ask us how we select such good officers. We made strong efforts with all counterpart staffs and made good accomplishments during last two years. We hope to make more accomplishments in 2015.

Mr. Leng Sovann, Deputy Director of the Department of Fish Processing and Quality Control asked:

Why the project does not promote local farmer to culture high-value species? For example, in Vietnam, they stopped to culture fish species targeted by the project, like silver barb, and changed to culturing high-value species for the market.

Dr. Hav Viseth answered:

In fact, the project has a clear direction to select target fish species for local farmer. Related to this point, we should keep in mind that local farmers of our targeted provinces are new to fish culture and live in poverty condition. They don't have enough capitals to invest fish culture. Thus, the project selects suitable fish species for poor farmer. The project target species can be cultured with less feeding cost. If we introduce high-value fish species, they need to invest and spend higher costs of production.

Moreover, I would like to tell you that most Vietnamese farmers also start to culture same fish species, which we introduced for new farmers in the project, before culturing high-value commercial fish species. For example, local farmers engaged in FAIEX-1 started easily-cultured fish species with low production cost. However, some of them currently culture high-value fish species. Evidently, in case of a farmer in Siem Reap province, the project encouraged him to culture tilapia, silver barb and common carp at the beginning. But, now he can culture sand goby and yielded around 1,000 ton/year. Hence, there is not any problems for local farmers to upgrade their knowledge and experiences of fish culture activities, once they used to culture low culture cost species at the beginning. As regards catfish species (Pangasuis and Clarias), the project also consider introducing additional technical guidance for catfish culture in training programs to build capacities of advanced seed producers.

Mr. Hong Hy, Director of South Tonle Sap Fisheries Administration Inspectorate asked,

As far as I know, many farmers engaged in the project suffered from large-scale floods in the first year. I would like to know whether those farmers continue to culture fish in the second year. This is an indicator to evaluate the sustainability of the project output.

Member of Japanese Evaluation mission Team answered,

Based on the field survey, we found that trained famers in early 2011, in general, still have a willing to continue to culture fish. About 40 percent of trained farmers could not continue fish culture due to drought and flood in 2012. However, they promise to restart fish culture in early 2013. The project team will go to the field to discuss with local fish famers about their commitment, whether they still want to be involve with the project or not.

Mr. Kong Sokha, chief for Battambang province suggested:

1. The project should increase the number of counterpart staffs
2. The project should promote the activities of rice fish culture in Battambang province
3. The project should urgently reinforce the capacity of seed producers selected for 3rd year.

4. Especially, it is very difficult for them to have nursery fish ponds.

Mr. Meng Thai suggested:

I would like to propose that the project provides more technical training programs for counterpart staffs and fish farmer as well as arrange study tours in the country and/or outside country.

Mr. Met Phannn, Seed producer in Battambong provicne requested:

1. The project should conduct training programs on seed production of catfish (*Pangasuis* and *Clarias*) 2 - 3 times per year.
2. The project should send 60 - 70 % of seed producers to visit foreign countries to study fish culture.
3. More study tours should be included during technical training programs on fish culture

Prof. Dr. Nao Thuok, Delegate of the Royal Government of Cambodia in-charge of Fisheries Administration: Director General stated:

With regard to the suggestion to Fisheries Administration to stop to issue licenses for importing fish seeds from other countries, I would like to clarify in this meeting that Fisheries Administration should stop to give license for import of fish seeds, when local seed producers can produce enough fish seeds to meet the domestic demand.

Last year, Fisheries Administration had not allow to import *Pangasuis* seeds, because local seed producers could produce them to meet their domestic demand. The training programs held in FAIEX-1 contributed to the situation, that local seed producers can produce enough *Pangauis* seeds. It resulted in stopping any imports of *Pangsuis* seeds from other countries. However, some persons still smuggle to import *Pangasuis* seeds from neighboring countries illegally.

With regard to *Clarias* seed production, the project concerned about environmental impacts in case African catfish broodstock escapes into the natural waters. It is a serious problem to maintain fisheries resources and the natural eco-system.

However, I would like to suggest that Cambodia has to increase the production of *Clarias* seed as much as possible, because there is a high demand of this catfish species among grow-out fish farmers. Cambodia has to stop importing *Clarias* seeds from other countries. Last year, Fisheries Administration stop to issue any license for importing *Pangasuis* seeds. Then, we should have stopped importing *Clarias* seeds at the same time. When local seed producers can produce a large amount of *Clarias* seeds, they will improve their living conditions, and do not lose money for buying fish seeds from other countries.

I accepted all suggestions raised in this meeting, such as expansion of farmers' networks and training for existing fish farmers to be core farmers. I strongly support the suggestion on assistance for digging nursery fish ponds for seed producers. I propose the project to consider supporting activities responding to this request. For the farmers, who have fish ponds but cannot produce fish

activities responding to this request. For the farmers, who have fish ponds but cannot produce fish seeds, we can teach how to nurse and breed more fish seeds. This is a good approach to increase job opportunities and generate incomes for individual households.

I agree with the suggestion on increase of the number of counterpart staffs. The project sites are located far away from fisheries offices, which face lack of workforce. We need more counterpart staffs at both central and provincial offices to be involved in the project activities.

Speaking about rice fish culture, some demonstration sites promote neighborhoods to visit and see their culture activities. As its response, Aquaculture Development Department should consider extending rice fish culture activities to all provinces, not only in three target project provinces.

National Hatchery Stations, like Bati and Toek Vill station, must produce qualified fish seeds. Then, station researchers and local fish farmers should make and keep a good collaboration to improve the quality of fish seeds.

Finally, I totally agree with all suggestions of the mid-term evaluation report. I propose the project to highly consider all suggestions. Thank you.

After that **His Excellency Mr. Por Try**, Secretary of the Ministry of Agriculture, Forestry and Fisheries, delivered his remarks to close the meeting as in the attached document **Annex 6.**

The meeting was ended at 12:00 of the same date under highly responsible, happy and extreme friendly atmosphere.

Phnom Penh, 13 February 2013

Minute writer

Meeting chairman

Annex 1

Agenda
for
The 2nd Joint Coordinating Committee (JCC) Meeting

13th February (Wednesday) 2013

At the Conference Room, Fisheries Administration

08:00 – 08:30	Registration
08:30 – 09:00	Opening Ceremony
	Welcome Speeches - Prof. Dr. NAO Thuok Director General, Fisheries Administration
	- Mr. Hiroshi Izaki Chief Representative, JICA Cambodia Office
	Opening Remarks - H.E POR Try Secretary of State, MAFF
09:00 – 09:30	Accomplishments from April 2012 to February 2013 (30 minutes)
09:30 – 10:00	Report on the result of Mid-term Evaluation, and PDM proposed by Evaluation team (30 minutes)
10:00 – 10:30	Annual Work Plan from April 2013 to March 2014 (30 minutes)
10:30 – 10:45	Breaks (15 minutes)
10:45 – 11:15	Plenary Discussions (30 minutes)
11:15 – 11:30	Signing of M/M for JCC Closing Remarks - H.E POR Try Secretary of State, MAFF

Annex 2

Ministry of Agriculture Forestry and Fisheries

Fisheries Administration

Name of participant

in 2nd Joint Coordinating Committee (2nd JCC) Meeting

for

"the Achievements in 2011-2012, Planning for 2013 and Mid-Term Evaluation of The Freshwater Aquaculture Improvement and Extension Project 2"

February 13, 2013 at 8:30 AM

under the presidency of His Excellency Por Try, secretary of state of the ministry of agriculture forestry and fisheries.

N.o	Name	Position	Institute	Telephone
1	H.E Por Try	Secretary of State of MAFF	MAFF	
2	Dr. Nao Thuok	Director General of FiA	FiA	
3	Dr. Hav Viseth	Director of DAD	FiA	
4	Chin Da	Deputy Director of DAD	FiA	011 980990
5	Haing Leap	Deputy Director of DAD	FiA	012 922224
6	Chhoun Kimchea	Deputy Director of DFA	FiA	016 886509
7	Kav Monirith	Deputy Director of FiA Inspectorate of Sakmuth	FiA	12583825
8	Leng Sovannara	Counterpart of JICA	Battambang	097 7072182
9	Krouch Sophak	Counterpart of JICA	Battambang	012 514434
10	Seng Songly	Counterpart of JICA	Pursat	092226127
11	Soum Sour	Counterpart of JICA	Battambang	092 380538
12	Yim Teang	Counterpart of JICA	Pursat	012 321137
13	Neang Nget	Counterpart of JICA	Pursat	016 723595
14	Mith Phan	Fish seed farmer	Battambang	097 6897948
15	Chin Kunthy	Fish seed farmer	Pursat	012 994825
16	Tieb Bunchhun	Official staff of FiA cantonment Siem Reap	Siem Reap	016 235070
17	Uy Sovanny	Official staff of FiA cantonment Siem Reap	Siem Reap	012 961204
18	Im Kanthavy	Official staff of FiA cantonment Siem Reap	Siem Reap	017 368466
19	Thai Seilalita	Deputy chief of FiA cantonment	Pursat	012 787032
20	Ros Vuthy	Deputy Director of FiA Inspectorate of Khang Chheung Boeung Tonle Sab	Kampong Thom	012 898398
21	Hong Hy	Director of FiA Inspectorate of Khang Tboung Boeung Tonle Sab	Pursat	17735169
22	Ouch Lang	Official staff of DAD	FiA	099 844668
23	Choung Sophea	Chief of FiA cantonment	Battambang	012 603160
24	Leng Sovan	Deputy Director of DFPTQ	FiA	017 882585
25	Nen Phanna	Official staff of FARDeC	Prey Veng	017 958676
26	Samrith Sambo	Deputy Director of MaFReDI	Kampong Saum	012 714239

27	Chhor Bunly	Official staff of DAD	FiA	012 892974
28	Chab Seakheng	Deputy Director of FiA Inspectorate of Chaktomok	Kandal	012 871071
29	Kim Savoeun	Official staff of FiA cantonment Siem Reap	Siem Reap	012 564534
30	Yim Prang	Fish seed farmer	Siem Reap	012 667295
31	Ros Kunthy	Official staff of DAD	FiA	017 461567
32	Sar Tita	Official staff of DAD	FiA	
33	Prak Viseth	Official staff of DAD	FiA	
34	Bun Rasy	Deputy Director of Fisheries conservation	FiA	015 915567
35	Meng Sothai	Chief of FiA Division Outaki	Battambang	012 358565
36	Prin Savin	Chief of FiA cantonment	Siem Reap	012 821584
37	Hang Savin	Deputy chief of Fish Seed Production Station 1	Kandal	092 434350
38	Kong Sokha	Deputy chief of FiA cantonment	Battambang	012 383361
39	Hip MorRa	Official staff of FiA cantonment Siem Reap	Siem Reap	012 512926
40	Srei KeovSopheak	Deputy chief of FiA Division	Siem Reap	012 350907
41	Seum Thavry	Deputy Director of IFReDI	FiA	
42	Kea Poleak	Deputy chief of FiA Division Chung Khneas	Siem Reap	012 947767
43	Hang Phal	official staff of FiA inspectorate of Mekong	Kampong Cham	089 677796
44	Thaung Thavy	Deputy chief of Admin of MARDeC	Kampong Saum	017 376879
45	Yok Sophea	Journalist	Journal	
46	Sreng Phonny	Deputy Director of DAD	FiA	

FiA - Fisheries Administration

DAD- Department of Aquaculture Development

DAAL - Department of Administrative Affairs and Litigation

DPFIC - Department of Planning Finance and International Cooperation

DFPTQ - Department of Fisheries Post-Harvest Technologies and Quality Control

DCFD - Department of Community Fisheries Development

IFReDI- Inland Fisheries Research and Development Institute

FARDeC - Freshwater Aquaculture Development and Research Center

MaFReDI - Marine Fisheries Research and Development Institute

MARDeC - Marine Aquaculture Research and Development Center

Annex 3

WELCOME ADDESS
by
Prof. Dr. Nao Thuok
Delegate of the Royal Government of Cambodia in charge of
Director General of Fisheries Administration in
the 2nd Joint Coordinating Committee (JCC) Meeting of FAIEX 2
FiA, 13 February, 2013

My respect to:

- **His Excellency Por Try** : Secretary of State of the Ministry of Agriculture, Forestry and Fisheries
- **Mr. Hiroshi Izaki** : Chief Representative JICA in Cambodia
- **Mr. Niwa Yukiyasu**:Chief of Advisor's the Freshwater Aquaculture Improvement and Extension Project
- Director of Five Fisheries Administration Inspectorate
- Director of Fisheries Administration Cantonment of Pursat, Battambong, and Siem Reap province
- Distinguished delegates and participants

I have my great pleasure to joint with His Excellency, Distinguished delegates and participants in the 2nd Meeting of Joint Coordinating Committee of the Freshwater Aquaculture Improvement and Extension Project, Phase II. This is the phase 2 of the FAIEX project "FAIEX2" covering in Pursat province, Battambong province and Siem Reap province run after the FAIEX1 with good accomplishments protected in Takeo, Kampong Speu, Prey Veng and Kampot province. This FAIEX2 is paying important role in enhancing of rural households' livelihood, especially Cambodians are facing of lacking fish for household consumption. Fisheries Administration through the Department of Aquaculture Development (DAD) in cooperation with JICA has been implementing aquaculture activities in above three targeted provinces and achieved a very good result as planned, reported by officials of DAD. Beside of fish grow-out activity, the project also support on seed production, in terms of freshwater prawn seed breeding, produced approximately one million larvae.

I do believe that the project will help improving rural households 'livelihood of these three provinces and progressing of aquaculture activities move toward. Finally, I wish His Excellency, Distinguished delegates and participants healthy, prosperity and success in all duties. Thanks!

Annex 4

Speech of Mr.Hiroshi Izaki, Chief Representative, JICA Cambodia Office
At the second Joint Coordinating Committee (JCC) for FAIEX-2 on 13 Feburary 2013

Excellencies, Ladies and Gentlemen

It is my great pleasure to make a welcome speech at the 2nd joint coordinating committee for Freshwater Aquaculture Improvement and Extension Project in Cambodia Phase 2, in short "FAIEX2".

On behalf of Japan International Cooperation Agency "JICA", I would like to express my sincere appreciation for your active participation and contribution to FAIEX2 and today's 2nd Joint Coordinating Committee. My appreciation also goes to the efforts of the Joint Mid-Term Review Team which conducted a survey for reviewing the Project.

Since March 2011, FAIEX2 have been implemented in Pursat, Battambang and Siem Reap Provinces. There are many implementing sites in this very wide area. Today the Joint Mid-Term Review Team will share findings and recommendations from its two-week's study.

I suppose that all the concerned persons might be facing similar difficulties more or less in each site to carry on the project activities. Therefore, this meeting is very important to all of us to exchange necessary information and opinions so that we can overcome the obstacles.

Looking back to the previous phase of FAIEX2, we call it "FAIEX" or "FAIEX One", it was implemented with fruitful outputs from 2005 to 2010 in different 4 provinces, namely Prey Veng, Takeo, Kampot and Kampong Speu Provinces. The approach of FAIEX1 could be a role model in the field of freshwater aquaculture for other countries. We are able to observe these 4 targeted provinces with many farmers growing up a lot of seeds and fingerings even now. This is one of our important goals for FAIEX2 as well. I am looking forward to seeing the same or better result of FAIEX2 in near future. So, please keep up your effort for promotion of aquaculture.

JICA always respects the ownership of the Royal Government of Cambodia and works in partnership to support the effort of Royal Government of Cambodia to contribute to the development of social and economic situation by her own. I hope you all understand the significance and the implication of this Project and expect your further commitment to the Project.

Once again, I would like to express my sincere appreciation for your active participation in today's JCC. I wish today's meeting generate fruitful, constructive and tangible suggestions to the Project.

Thank you very much for your kind attention. End

End

Annex 5

OPENING REMARKS

by

His Excellency Por Try

Secretary of State of the Ministry of Agriculture, Forestry and Fisheries

in

the 2nd Joint Coordinating Committee (JCC) Meeting

FiA, 13 February, 2013

Good Morning, May I give my respect to ;

- **Prof. Dr. Nao Thuok** : Delegate of the Royal Government of Cambodia in charge of Director General of Fisheries Administration
- Madam Heng Sokun Vice Secretariats of .. KCna /kGk
- **Mr.Hiroshi Izaki** : Chief Representative JICA in Cambodia
- Japanese Evaluation mission Team and JICA experts in Cambodia
- **Mr. Niwa Yukiyasu** : Chief of Advisor's the Freshwater Aquaculture Improvement and Extension Project
- Director of Five Fisheries Administration Inspectorate
- Director of Fisheries Administration Cantonment of Pursat, Battambong, and Siem Reap province
- Distinguished delegates and participants

I, on behalf of the Ministry of Agriculture, Forestry and Fisheries, have a high gratitude to joint with His Excellency, Distinguished delegates and participants in the 2nd Meeting of Joint Coordinating Committee of the Freshwater Aquaculture Improvement and Extension Project, Phase II. The objectives of the meeting aim at verifying on the achievement of the project implementation of last year through the result of mid-term review team and discuss on the indicators and project plan for next two years till early of 2015 enabling quote experiences and improve activity plan to further move toward effectively.

The project, entitled "Freshwater Aquaculture Improvement and Extension Project, Phase II" is a continuous project of phase1 "FAIEX1" with five-year period had been successfully implemented in four provinces, namely Takeo, Kampong Speu, and Prey Veng province started from February 2005 to Feb 2010. The good accomplishments of

Annex 5

FAIEX1 came up with strong effort of all concerned fisheries administration cantonment together with project's counterpart officials who are always a good subordinate of fisheries administration, and under the full support from MAFF. Therefore, all of us must try our effort for project of phase2 "FAIEX2" to be able to produce a proper result by picking up good experiences from project of phase1 "FAIEX2" and as well as try our best to search further adequate method to support the implementation of FAIEX2, enabling to receive more success.

Sooner after this, we will see all of achievable results of FAIEX2 within last two years performance, as well as make discussion on indicators and next two years plan till early year of 2015 of the project in three targeted provinces, Pursat, Battambang and Siem Reap province. I do truly hope that Aquaculture Development Project supported by JICA will continue to assist Cambodian people in producing enough fish for their household consumption and generating more income for family economic, contributing in poverty reduction of Cambodians that this is a supportive activity in parallel with rectangular strategy of the Royal Government of Cambodia.

On behalf of the Ministry of Agriculture, Forestry and Fisheries, I express my sincerely thanks to the Royal Government of Japan and JICA has kindly provided financial assistant to Cambodia Government to promote and improve freshwater aquaculture in the rural area. I am sure that, this project has been improving rural households' livelihoods in project targeted provinces, and disseminating found technology to other provinces, this is a good extension program nationwide aimed at better improvement of poor farmers' living condition. Moreover, all project' finding is considering by some countries like Benin and Laos used to send delegate to quote good experiences from Cambodia.

Finally, I wish His Excellency, Distinguished delegates and participants healthy, prosperity and success in all duties. Thanks!

Annex 6

CLOSING REMARKS
by
His Excellency Por Try
Secretary of State of the Ministry of Agriculture, Forestry and Fisheries

in
the 2nd Joint Coordinating Committee (JCC) Meeting
FiA, 13 February, 2013

Distinguished delegates and participants
JICA representative to Cambodia!

I, on behalf of the Ministry of Agriculture, Forestry and Fisheries, express my sincerely thanks for His Excellency, Distinguished delegates and participants attended, discussed and provided a very good comments and recommendation for the 2nd Meeting of Joint Coordinating Committee on the achievement of the project implementation of last year through the result of mid-term review team on the project, entitled "Freshwater Aquaculture Improvement and Extension Project, Phase II" has been implemented. The meeting will improve management work and technical updating on aquaculture development with proper technology to move this activity toward sustainably. I am please to express my great pleasure and applaud with result of this meeting even conducted in the short period but all participants tried an effort to share idea, comment and recommendation under close relation with high responsibility.

Ladies and Gentlemen

Recently, aquaculture activity is gradually progressing causing the increasing number of fish farmer from year to year. This is due to high attention of the Ministry of Agriculture, Forestry and Fisheries and fisheries administration has been conducting the Freshwater Aquaculture Improvement and Extension Project and other aquaculture development partners. Throughout presentation on the result of FAIEX2 has been promoting and encouraged more than 1,400 farmers to participate in fish culture activity. Through the presentation clearly stated that 30 farmers from Pursat, Battambong and Siem Reap province were trained to be seed producer farmers, further this the project also build further capacity of these 30 seed producer farmers to be a core project farmers which will be a good actor in disseminating fish culture technique to other farmers. Therefore, the number of grow-out farmers will be increased before end of project at early 2015. The project is not only provide technical and extension training course to famers, but also support in research activity in th Toek Vill Freshwater Hatchery Station, Siem Reap province and then all findings from the research are sharing and disseminating to farmers. Moreover, the project also support on the fish

refuge pond activity to existing natural water bodies locally as well as management of fisheries resources in order to use sustainably and effectively.

Based on the development activity I do believed that from year to year aquaculture activity and rural fisheries resources management throughout strengthening community fish refuge pond will move toward, this is due to the fact that extension effort of the project will help farmers and community group participating in disseminating fish culture technique and management approach in local fisheries resources management and sharing to other community in other region.

I would like to take this opportunity to applaud with this good result of the project has been implementing so far even the project were facing with some constraints during the project performance, however this matter will be our lesson-learned for our future solution. I do agree with result of mid-term review team and planning for next two year of FAIEX2 raised during the meeting. However, in order to achieve our plan there is a need of good cooperation and collaboration from all of Coordination Committee Members with national hatchery stations, private pisciculturist, and all community fish refuge ponds, as well as concerned NGOs in research and extension activity aims to promote grow-out and seed production activity, and ensure the sustainability of local fisheries resources enably support the demand of fish for local community based aquaculture development and management of local fisheries resources. I do believe that the meeting today is a key approach to be able to address any matters and to gain success in the future. Once again, on behalf of the Ministry of Agriculture, Forestry and Fisheries, I express my great thanks to the Royal Government of Japan and JICA that always both technical and financial support to the Royal Government of Cambodia in field of freshwater aquaculture development and promotion. I anticipate that Royal Government of Japan and JICA will continue to support to other provinces in the future enabling to give an opportunity to other poor rural households to have enough fish for home consumption as well as household income generation, this will contribute to the Government policy in poverty reduction of rural households.

I also express my deep thanks for His Excellency, Distinguished delegates and participants expanded your value time to attend the meeting and proudly produce a fruitful result.

Finally, I wish His Excellency, Distinguished delegates and participants healthy, prosperity and success in all duties. I declare to close the 2nd Meeting of Joint Coordinating Committee from now on.

Thanks!

THE MINUTE OF THE THIRD JOINT COORDINATING COMMITTEE MEETING
CONCERNING
THE JAPANESE TECHNICAL COOPERATION
FOR
THE FRESHWATER AQUACULTURE IMPROVEMENT
AND EXTENSION PROJECT PHASE 2 (FAIEX-2)
IN
KINGDOM OF CAMBODIA

In accordance with articles of the Record of Discussions (hereinafter referred to as "the R/D") signed on January 10, 2011, Cambodia authorities concerned and the Project decided to hold the second Joint Coordinating Committee Meeting (hereinafter referred to as "the Meeting") on March 20, 2014.

During the Meeting, accomplishment from April 2013 to March 2014, work plan from May 2014 to February 2015 were presented as the agenda of the Meeting.

Attendants of this meeting exchanged views and discussed in respect of necessary measures to be taken by both Cambodia and Japanese sides for further successful implementation of the Project.

The both sides of attendants concerned the Project agreed to recommend to their respective Governments the matters referred to in the document.

Phnom Penh, March 20, 2014

Mr. TAKEUCHI Hiroshi

Deputy Resident Representative
Japan International Cooperation Agency Cambodia Office

H.E Dr. Nao Thuok

Delegate of the Royal Government of Cambodia
Director General, Fisheries Administration, Ministry of Agriculture, Forestry and Fisheries

Project Director
The Freshwater Aquaculture Improvement and Extension Project Phase 2 in Cambodia

The MINUTES
of
The Third Joint Coordinating Committee Meeting on
"Achievement of Year 2013" and "Work Plan for Year 2014"
of
Freshwater Aquaculture Improvement and Extension project Phase 2 (FAIEX-2)

20 March 2014

On March 20, 2014 at 8:30 am at the Inland Fisheries Research and Development Institute, there is the Third Joint Coordinating Committee Meeting of the Freshwater Aquaculture Improvement and Extension Project Phrase II", that is under presidency of His Excellency Yuth Phuthang, Secretary of State of the Ministry of Agriculture, Forestry and Fisheries.

List of participants is attached in Annex 2:

At the beginning, **Mr. Chin Da**, Deputy Director of Department of Aquaculture Development of the Fisheries Administration announced the meeting agenda and highlighted the objectives of the meeting as annual meeting to show the achievement of project activities implemented in three target provinces, Pursat, Battambang and Siem Reap. Then, the implementation plan scheduled for the year 2014 was highlighted to share among all participants.

Next, **His Excellency Nao Thuok**, Delegate of the Royal Government of Cambodia, Director of Fisheries Administration, delivered his welcome remark to the whole meeting as in attached document **Annex 3.**

Welcome address in Annex 3:

Mr. **Hiroshi Takeuchi,** Senior Representative, JICA Cambodia Office stated his remark as in the attached document Annex 4.

Keynote speech in Annex 4:

After that His Excellency Yuth Phuthang, Secretary of State of the Ministry of Agriculture, Forestry, and Fisheries delivered his remarks and open the meeting as in the attached document Annex 5.

Opening remarks in Annex 5:

After that, Dr. Hav Viseth, gave a presentation on Accomplishments from May 2013 to March 2014.

Next, Mr. Chin da, gave a presentation on Work Plan for the 4th Year May 2014 - February 2015.

After all presentations finished, video of rice-cum fish culture, output product of project was showed while tea-break time. After all participants watched video, plenary discussion started as below.

Question, Answer and Requests in Plenary Discussions (30minutes)

Mr. **Srun Limsong**, Deputy-Director of Fisheries Administration

I am very interested in the video on rice-cum fish culture that is showing us real case of increasing both rice and fish production throughout project actively. I suggest that this should be disseminated more actively and we should produce many copies of film and should distribute to more people.

Moreover, for the farmers who have no video players to be able to watch broadcasting in Agriculture programs on TV, this program should be transmitted in the TVK as frequent as possible. And furthermore, I would like to ask JICA project to help producing the posters to distribute for displaying on the walls so that people can see it anytime, anywhere. Many times they can be attracted one day rather than producing the booklets that they just read one time and leave behind, or sometime they are illiterate. Thus, the posters should be made to impress the farmers in whole country.

Her Excellency **Heng Sokun**, Deputy-Director General of CRDB/CDC asked:

1. How to select seed farmer? What are the criteria for selecting the fish seed producers?
2. Is it in contrary to the objective of the project or not that in the fourth year of project implementation, new fish seed producer is not selected?

Dr. **Hav Viseth** answered :

For the first question, the criteria for selecting the fish seed producers are as follows:

1. Select 1st year seed farmer from the existing seed farmers. It means that before the commencement of the project, they have the resources, water source.
2. Since the 2nd year, select seed farmer from the grow-out farmers who have been trained in the first year. Candidate farmer should have strong willingness, resources, laborers, consensus in the family, water sources. Our project checked it by filed observation and individual interview survey.

For the second question,: We do not select new fish seed producers because fourth year is the final year, which is limited of time, so we do not have much time for selection process, as the project will be faded out sooner.

Mr. **Chin Da** added answer to first question from Her Excellency **Heng Sokun**:

For the selection of grow-out farmers as well as fish seed producers, the selection criteria are:

1. There are many fish ponds in that commune
2. No flooding
3. The water resources are existing (at least water can be reserved for 6 months)
4. There is the consent from the family
5. Involvement from the local authorities (support could be expected)

During Plenary Discussions, some seed farmer (representative provincial seed farmer network) also gave some comments.

Mr. **Say Sorn**, fish seed producer from Siem Reap province stated his experience in producing the fish seeds so far:

Before the presence of the technical assistance of the project, I had been cultured and produced the fish for 3 years and failed every time because I did not have any experience and techniques. After my failures, I was supported with technical assistance and actual practices from Aquaculture Development Department so that I am successful now. So far I have been supported by some organizations including UNDR (provided a 4m floating cage), FAO (provided 3 tanks for fish seed culturing), and JICA helped provide technical assistance on fish seed production, including some support of equipment such hormones, broodfishes etc.

After that I was introduced some techniques by Siem Reap provincial fisheries cantonment officers and extension officers of JICA project so that I have the results as today.

Lastly I would like to request JICA and other institutions concerned to help dispatching more farmers to learn new experiences from abroad to share to other farmers in the country.

Then, Mr. **Yib Prom**, a fish seed producer in Siem Reap province described his experience on fish seed production:

Before getting successful results as a seed producing farmer, I faced a lot of failures because I did not know about the techniques but I never give up and keep hope. I tried and tried until I get successful.

Together with this, I was supported by Fisheries Administration collaborated with Siem Reap provincial fisheries cantonment and JICA with technical trainings on fish seed production, I also was provided with seeds, broodfish, hormones and the JICA project assisted me to attend various meetings on sharing the experiences with other farmers and also supported me to go to Indonesia to learn new technique from overseas country.

These factors make me successful as today. Together with this, we have to keep in mind the main factors that makes us successful: (1) Trying, (2) Being patient, (3)Being persistent .

Mr. Yib Prom requests JICA and other institutions concerned to send farmers to other countries where the advanced aquaculture development take place for me or for other ambitious farmer to absorb more knowledge for the sake of better and more successful practices.

HE,Nao Thuok, Delegate of the Royal Government of Cambodia in charge of Fisheries Administration stated that:

Regarding the loss of 4 farmers among selected 44 farmers as presented, where 4 of them, 10% in proportion, are inactive due to family problem, therefore, is there any possibility that the project can help them? They have been already selected as applied proper selection criteria. Although I am not sure about the exact reason of family issues, I think there should be any possibility for activate them again.

Anyway, according the film displayed and presentation, I fmd that the slope of the channel is too sharp; however, the outcome demonstrated by project satisfied us.

In the result figure, the fish production increased from 50 kg to 150 kg, it means if the land area would be 1 hectare, the production would be 1 tone.

In addition, paddy rice production is even more increases; if there is not fish culturing in rice field, the rice production is only 1 ton per hectare, but if there is fish culturing in the rice field, the rice production rise up to 4 tons per hectare. It is marvelous, so I would like to suggest the plan forward 2014 to promote this method that can bring more benefit both fish and rice productions.

Hence, it is conforming to the Rectangular Strategy, phase-3 of the Royal Government of Cambodia that can benefit both fish and rice production assisting the livelihood of the farmers. As a result, I would like to propose that the project should take into the consideration the enhancement of the rice-cum fish culture more and more and as the ground for other chiefs of fisheries cantonments to adopt and H.E Srun Limsong needs to include this method into EU project.

Department of Aquaculture Development needs to plan the further promotion of rice-cum fish culture as many as possible to be 100 hectors in one fisheries cantonment.

Even there are 2 million hectors of rice field area in the country, it still be small amount in comparative. Therefore, there should be introduction for the people in other provinces to visit such rice-cum fish culture demonstration site in this FAIEX-phase 2. These sustainable practices demonstrated and adopted in 3 provinces have to be broadened to all provinces throughout the country.

Rice-cum fish culture can reduce the usage of chemical fertilizer while both fish and rice production are all increased. This will contribute the strategy of the Royal Government of Cambodia that 1 million ton rice will be exported in 2015 and we can produce more organic rice like this. We should increase such rice-cum fish culturing system more in our project as many as possible.

Dr Have Viseth answered:

Thank your Excellency as well as H.E chairman of the meeting very much.

Related to the question from H.E Delegate about the four inactive farmers whether they can be activated or not, I think that Your Excellency, they would have some private difficulties such family issues.

In Pursat province, there are 2 families; first family there is the incompatible between son-in-law and father-in-law and another family. Then in second family, the father was killed by attacking a thunderbolt last year, but they still have capability to produce approximately ten to twenty thousand fish seeds per year. In case of another family in Battambang province, there is no possibility to activate because they sold the land already and immigrated to other town. Regarding the family in Siem Reap province, they are too busy with other businesses, so there is no labor for this work.

In relation to the plan for 2014, regarding further promotion of rice-cum fish culture as mentioned by Your Excellency, we will discuss more with Mr.NIWA and JICA to arrange the plan of the promotion.

After that **H.E. Yuth Phuthang,** Secretary of State, MAFF delivered his remarks to close the meeting as in the attached document **Annex 6.**

The meeting ended at twelve o'clock of the same date under the highly responsible, happy and extreme friendly atmosphere.

Phnom Penh, 20 March 2014

Minutes writer

Meeting chairman

THE MINUTE OF THE FOURTH JOINT COORDINATING COMMITTEE MEETING
CONCERNING
THE JAPANESE TECHNICAL COOPERATION
FOR
THE FRESHWATER AQUACULTURE IMPROVEMENT
AND EXTENSION PROJECT PHASE 2 (FAIEX-2)
IN
KINGDOM OF CAMBODIA

In accordance with articles of the Record of Discussions (hereinafter referred to as "the R/D") signed on January 10, 2011, Cambodia authorities concerned and the Project decided to hold the Fourth Joint Coordinating Committee Meeting (hereinafter referred to as "the Meeting") on September 10, 2014.

During the Meeting, outputs and progress of the project in the mid-term of the year 2014 (from April 2014 to September 2014), Joint Terminal Evaluation Report were presented as the agenda of the Meeting.

Attendants of this meeting exchanged views and discussed in respect of necessary measures to be taken by both Cambodia and Japanese sides for further successful implementation of the Project in remained period.

The both sides of attendants concerned the Project agreed to recommend to their respective Governments the matters referred to in the document.

Phnom Penh, September 10, 2014

Mr. TAKEUCHI Hiroshi

Deputy Resident Representative
Japan International Cooperation Agency Cambodia Office

H.E. Prof. Nao Thuok

Delegate of the Royal Government of Cambodia
Director General, Fisheries Administration, Ministry of Agriculture, Forestry and Fisheries

Project Director
The Freshwater Aquaculture Improvement and Extension Project Phase 2 in Cambodia

The MINUTES
of
The Fourth Joint Coordinating Committee Meeting on
of
Freshwater Aquaculture Improvement and Extension project Phase 2 (FAIEX-2)

10 September 2014

On September 10, 2014 at 8:30 am at the Inland Fisheries Research and Development Institute, there is the Fourth Joint Coordinating Committee Meeting of the Freshwater Aquaculture Improvement and Extension Project Phrase II", that is under presidency of His Excellency Yuth Phuthang, Secretary of State of the Ministry of Agriculture, Forestry and Fisheries.

At the beginning, **Mr. Chin Da**, Deputy Director of Department of Aquaculture Development of the Fisheries Administration announced the meeting agenda and highlighted the objectives of the meeting as annual meeting to all participants.

- **Welcome address**

Next, **His Excellency Nao Thuok**, Delegate of the Royal Government of Cambodia, Director General of Fisheries Administration, delivered his welcome remark to the whole meeting.

- **Keynote speech**

Mr. **Hiroshi Takeuchi**, Senior Representative, JICA Cambodia Office stated his remark.

- **Opening remarks**

After that His Excellency Yuth Phuthang, Secretary of State of the Ministry of Agriculture, Forestry, and Fisheries delivered his remarks and open the meeting.

- **Presentation**

Dr. Hav Viseth, gave a presentation on outputs and progress of the project in the mid-term of the year 2014 (from April 2014 to September 2014).

Next, Joint Terminal Evaluation team presented the results of evaluation.

First, Ms. Ohashi gave a presentation on Joint Terminal Evaluation Report.
Next, Mr. Chin Da gave a presentation on Lessons learned and Recommendation for the remained period of the project.

After all presentations finished, all agenda and topics were discussed as mentioned below.

Question, Answer and Requests in Plenary Discussions (30minutes)

Dr. Nao Thuok: Director-General of Fisheries Administration (FiA)

- According to the last presentation, the project has made many challenges and achieved great outcomes. As presented by Dr. Viseth, the security condition in communes is one of selection criteria for target communes. Actually, nowadays, the security for field activities is not a serious issue.
- The networking groups organized by the project comprise the fish seed producers (core famers) trained / supported by the project. Other fish seed producers, who have not participated in the project, also will join the networking groups in the future. Not enough customers of fish seeds is one of serious problems on fish seed producers. Therefore, the networking group should work to find / raise new customers of their fish seeds.
- In order to maintain the outcomes of the project, we expect to extend the project period.
- Technical information developed by the project should be widely disseminated in Internet, such as Facebook or YouTube. Through the Internet, many people can access technical information on fish culture and fish refuge pond. Actually, Department of Aquaculture Development has started the Facebook site named as "Cambodia Aquaculture". We should share the achievements of the project with other local people, who are interested in fish culture.
- We need to produce more fish seeds to promote fish culture. By the project, we have a capacity for producing 3 million fingerlings in a year. Actually, local demand of fish seeds is much higher. I expect that it is 300 million of fish seeds. At the current situation, we have to import fish seeds, such as tilapia and catfish, from other countries. Local seed producers make effort to produce more fish seeds to the local demand.
- In the project, we have learned many skills and knowledge on fish breeding. We should utilize those skills and knowledge to contribute to livelihood improvement of local farmers. Then, if producing a surplus of fish seeds, we will export the surplus.
- Currently, we can produce 2 million seeds of freshwater prawn in Takeo and Kampot by the cooperation of JICA project. We have more local demand of freshwater prawn seeds, 6 million. However, our capacity of seed production in freshwater prawn does not meet the local demand. Many local farmers are also interested in seed production in freshwater prawn. We should move forward.

Mr. Mith Pan: President of Networking Group in Battambang Province

- I tell you that the project is successfully completed. Based on the learning in the project, I will continue to produce more fish seeds.
- Before the project, I had only one fishpond. Now, I have 10 ponds for fish seed production. My income has been increasing up to R 8 million from R 3 million by fish seed production. In rice farming, I can earn only R 1 million in 1 ha field. I will never stop my activities of fish seed production. It contributes to my livelihood.
- Other fish seed producers in Battambang also should keep their production activities. However, they still have some difficulties in getting hormones and finding brood fish at local markets. Our networking group will support them by close communication. We should be ready for a future competition with the importation of fish seeds from neighbor countries.
- We expect that the project will provide more supports, because our seed production technologies are still at low level.

Mr. Yip Prang: Core Farmers in Siem Reap Province

- A networking group has made many progresses of core farmer's activities. However, some newly selected core farmers does not have sufficient technologies on stable production of

fish seeds. I suggest that the project will support their activities.

- I hope that the project will continue to support our activities and provide new applied technologies on fish seed production under a shortage of water supply. It is very applicable in the case of Cambodia.
- I hope that JICA will support to transfer a technology on freshwater prawn breeding in Siem Reap. We should upgrade our technologies, and move to next step. It is important to keep contact each other between core farmers and FiA officers.
- Local farmers always look for good quality fish seeds. Low-quality fish seeds often discourage them to continue fish culture. If we can produce high-quality fish seeds, we may export them in the future.

Mr. Say Som: President of Networking Group in Siem Reap Province

- I appreciate that the project provided technical and financial assistance to start my fish seed production. Rice farming does not afford our livelihood.
- Core famers does not have sufficient market of fish seeds. It is a serious problem. Some farmers are difficult to access the proper technologies, because they live at isolated places. Therefore, they cannot produce enough amount of fish seeds on time corresponded the demand of local market.
- In the sale of fish seeds, the quality of fish seeds should be good. If not so, customers do not enjoy our fish seeds.

Mr. Chin Kunthy: President of Networking Group in Pursat Province

- Thank for FiA and the project supports. We can make good income and improve our livelihood. Moreover, we have improved our knowledge on fish culture by the supports of FiA and extension staffs.
- Newly selected core famers also intend to produce more fish seeds. Please continue to give your supports.

Mr. Phom Vimol : Chief of Fisheries Cantonment Office in Pursat Province

- Based on my observation, the project has achieved the planned goals. Next year, the project will complete and finish. I have both feeling, happy and unhappy.
- By the project, Cambodia people become much interested in fish culture. I hope that JICA will provide additional supports to newly selected fish farmers, because their knowledge and experiences are still limited.
- The promotion of small-scale fish culture does not make enough capacity of fish production in Pursat Province. a medium or large-scale fish culture project will be necessary. It attracts more people to fish culture, and contributes to the increase of fish production.
- Management of fish refuge ponds in communities should be promoted to other communities, because more people are interested in it. Currently, there are 21 communities, which join fish refuge pond activities in the province.

Mr. Meng Sothai: Extension Officer in Cantonment Office in Battambang Province

- We estimate the potential fish production in Battambang province is 70,000 tons. There are many irrigation systems in the province, we should utilize them for fish production. Especially, medium or large-scale fish culture will be needed to increase the productivity of fish culture.
- The JICA project should provide a budget for extension activities for follow-up programs in fish refuge pond, fish seed production and fish grow-out culture. Especially, it is necessary to support new fish famers selected in 2013 and 2014.
- The project mainly made great achievement in fish breeding. The project also should much focus on fish grow-out culture to increase fish production.

Mr. Leng Sovanara: Extension Officer in Cantonment Office in Battambang Province

- Before the project, our extension officers had only limited knowledge on fish culture. The project participation is a great benefit to improve our technical knowledge and skills. The technical knowledge and skills are also transferred the academic, to University of Battambang. At last, the numbers of fish seed producers and fish grow-out farmers has rapidly increased in the province.
- We should consider the sustainability on fish seed production. Some fish seed producers does not have capacities to produce enough fish seeds. They also have market problem on fish seed sale. Those situations makes the shortage of fish seed supply in the province.
- The profitability of fish seed production is also important. Farmers expect much income in fish seed production. Even though investing much cost of preparation of facilities, they are not sure to get income from fish seed sale. We should consider the balance between expenditure and revenue carefully. Otherwise, they will move out to find new jobs.
- Some fish seed producers live far away from the town. I am not sure that they continue to attend network meeting in the future.

Mr. Kong Sohka: Vice Chief in Cantonment Office in Battambang Province

- JICA project introduces a rice-cum-fish culture system to local farmers. This assistance is good for local famers.
- In terms of sustainability, even though farmers have strong commitments, their minds and ideas often changed by various reasons. In fact, in the project, many rice fields have been changed into fishponds. I am not sure that we can prevent from the import of fish seeds. However, we should keep producing fish seeds and raising fish farmers. Natural disasters are larger disturbing factor; but also challenges.
- I expect the new phase 3 project to support fisheries officers, fish seed producers and fish grow-out farmers.
- Making fish feeds is one of issues in fish culture. Farmers spend much money for purchasing commercial feeds. We should reduce feeding cost by the introduction of fish feed making skills. Fish disease treatment is another issue for fish culture skill.
- It is also important to secure good quality brood fish. High-quality brood fish produce good fish seeds. Teok Vil station should function properly to provide good quality brood fish in the future.

Dr. Hav Viseth: Director, Department of Aquaculture Development, Fisheries Administration

- FAIEX-1 raised 10,000 fish farmers and FAIEX-2 has raised 3,000 farmers. In the project, totally 13,000 farmers engage in fish culture. For the next step, if possible, the project will move to a commercial-scale program to create affordable jobs in the country.

Mr. Hiroshi Takeuchi: Senior Representative of JICA Cambodia Office
Leader of Terminal Evaluation Team

- In the strategy for the fisheries sector, fishery, aquaculture and quality control are important pillars. This Project also plays important role in fisheries administration in Cambodia.
- I would like to express my deepest appreciation to the farmers who sincerely work for seed production and largely contributed to the success with taking the big risk of investment.
- Also, in JICA project, local fish farmers can produce much fish. I appreciate the daily works of cantonment office staffs to contribute the project activities.
- Fisheries Administration has several focusing topics; fisheries & aquaculture promotion, fish processing, fish diseases, fishing lot's management, fishermen organization, and sustainable resource management. Among those topics, the project has enhanced aquaculture development especially. The project also indirectly contributes to organizing

local farmers and sustaining fisheries resources.

- We expanded the project period in 4 years from the phase 1 to promote freshwater aquaculture in national wide. Additionally, the project supports core farmers and Teok Vil station financially. Then, the project extends applied skills to local famers in cooperation with cantonment office staffs. Moreover, the FiA central office staffs got planning and operational capacities in project management. Finally, the day of project completion comes now.
- We will make our best for aquaculture development in a remaining project period to contribute to better production of core farmers and grow-out farmers. As you know, the budget of our office is limited. Our office has decided not to extend the project.
- We encourage the FiA to utilize own capacity of good administration. It will contribute to the people in Cambodia. So, the FiA will take initiatives to extend the technologies in the remaining period. It makes cantonment office staffs and core farmers understand more fish culture. Finally, our project will be completed successfully.
- I expect that the FiA will take strong initiatives and cooperation with cantonment offices to strengthen the networking activities for brushing-up of their skills by themselves.

After that **H.E. Yuth Phuthang,** Secretary of State, MAFF delivered his remarks to close the meeting.

The meeting ended at twelve o'clock of the same date under the highly responsible, happy and extreme friendly atmosphere.

Phnom Penh, 10 September 2014

Minutes writer

Meeting chairman

MINUTES OF MEETING

BETWEEN

THE JAPANESE TERMINAL EVALUATION TEAM AND THE FISHERIES ADMINISTRATION OF MINISTRY OF AGRICULTURE, FORESTRY AND FISHERIES

OF THE ROYAL GOVERNMENT OF CAMBODIA

ON

THE JAPANESE TECHNICAL COOPERATION

FOR

THE FRESH WATER AQUACULTURE IMPROVEMENT AND EXTENSION PROJECT (PHASE II)

The Japanese Terminal Evaluation Team organized by Japan International Cooperation Agency (hereinafter referred to as "JICA") and the Cambodian counterparts of the authorities concerned formed a Joint Terminal Evaluation Team (hereinafter referred to as "the Team") for the purpose of conducting the Terminal Evaluation for the Freshwater Aquaculture Improvement and Extension Project (Phase II) (hereinafter referred to as "the Project") from August 26 to September 10, 2014. The Team has carried out a series of evaluation activities such as reviewing documents and interviewing relevant personnel and exchanged views about the finding and recommendations.

As a result of these exercises, the Team agreed upon the matters as described in the Joint Terminal Evaluation Report attached hereto.

Phnom Penh, September 10, 2014

Mr. Hiroshi Takeuchi	H.E. Prof. Nao Thuok
Leader	Director General
Japanese Terminal Evaluation Team	Fisheries Administration
Japan International Cooperation Agency	Ministry of Agriculture, Forestry and Fisheries
Japan	Kingdom of Cambodia

JOINT TERMINAL EVALUATION REPORT

ON

THE FRESHWATER AQUACULTURE IMPROVEMENT AND EXTENSION PROJECT PHASE-2 IN THE KINGDOM OF CAMBODIA

Phnom Penh, September 10, 2014

Japan-Cambodia
Joint Evaluation Team

Contents

Annex 5: List of Inputs by Japanese Side

Annex 6: List of inputs by Cambodian Side

List of Acronyms

CFR	Community Fish Refugee
C/P	Counterpart
DAD	Department of Aquaculture Development
FAIEX	Freshwater Aquaculture Improvement and Extension Project
FiA	Fisheries Administration
FSP	Fish Seed Producer
FTF	Farmer to Farmer (Training)
JCC	Joint Coordinating Committee
JFY	Japanese Fiscal Year
JICA	Japan International Cooperation Agency
JPY	Japanese Yen
M/M	Man/Month
NGO	Non-Governmental Organization
NSDP	National Strategic Development Plan
ODA	Official Development Assistance
PCM	Project Cycle Management
PDM	Project Design Matrix
R/D	Record of Discussions
USAID	United States Agency for International Development

Chapter 1: Introduction

1-1. Objectives of the Terminal Evaluation

1) To evaluate the overall achievement of "the Freshwater Aquaculture Improvement and Extension Project (FAIEX) (Phase II) (hereinafter referred as "the Project") in terms of five evaluation criteria (Relevance, Effectiveness, Efficiency, Impact and Sustainability) and its implementation process based on Record of Discussions (R/D), Project Design Matrix (PDM) and Plan of Operations.
2) To confirm degree of implementation of the recommendations by the Midterm Review Team (Feb. 2013) and discuss the necessary measures to be taken for completion of the Project by its termination.
3) To conduct a joint study and a series of discussion with the concerned authorities of Cambodian government in order to gather necessary information to verify the outcomes of the inputs for the project and the tasks to be carried out by the government/Fisheries Administration (FiA) after the termination of the Project.
4) To extract lessons learned from the Project as reference for the other similar projects.

1-2. Members of the Joint Terminal Evaluation Team

(1) Japanese team

Name	Role	Position/Organization
Mr. Hiroshi Takeuchi	Team Leader	Senior Representative, Japan International Cooperation Agency (JICA) Cambodia Office
Dr. Masahiro Yamao	Rural Agriculture and Fishery Development	Professor, Graduate School of Biosphere Science, Hiroshima University
Mr. Satoshi Chikami	Freshwater Aquaculture Technique	Senior Advisor, JICA
Ms. Yuki Ohashi	Evaluation Analysis	Consultant, Tekizaitekisho, LLC.
Ms. Haruko Toyama	Evaluation Planning	National Staff, JICA Cambodia Office
Ms. Naoko Ide	Cooperation Planning	Project Formulation Advisor, JICA Cambodia Office

(2) Cambodian side

Name	Role	Position/Organization
H.E. Dr. Nao Thuok	Team Leader	Director General, Fisheries Administration (FiA), Ministry of Agriculture, Forestry and Fisheries
Dr. Hav Viseth	Director	Director, Department of Aquaculture Development (DAD), FiA, Ministry of Agriculture, Forestry and Fisheries
Mr. Chin Da	Deputy Director	Deputy Director, DAD, FiA, Ministry of Agriculture, Forestry and Fisheries

1-3. Schedule of the Terminal Evaluation

The schedule of the Terminal Evaluation is attached as Annex 1.

1-4. Background of the Project

Cambodia has abundant freshwater fisheries resources produced in Lake Tonle-Sap and Mekong River. Freshwater fishes are one of animal protein sources, which local people can obtain most easily. In fact, fisheries product accounts for about 76%[1] of animal protein which Cambodian people take in. Annual consumption of fisheries products per capita is estimated as 63kg[2]; however, the main fishing grounds are limited at Tonle-Sap Lake and a basin of Mekong River, and the distribution infrastructure is not well prepared. Therefore, the supply of freshwater fish is always short at other rural areas; then, it is a reason for disturbing the improvement of nutrition condition of local farmers. In addition, in order to diversify the variety of food products, improve the nutrition by protein intake, and generate cash income sources, the demand of small-scale fish culture, utilizing paddy fields, canals, and ponds, is very high. However, because rural communities have not experienced fish culture traditionally, the shortages of knowledge of fish culture and fish seed hinder the fish culture practices at farmers' households.

According to those situations above-mentioned, Cambodian Government, with the assistance of Japanese Government, conducted the Freshwater Aquaculture Improvement and Extension Project (FAIEX-1) at 4 southern provinces (Prey-Veng, Takeo, Kampong-Speu, and Kampot) from February 2005 to February 2010. The project could disseminate fish culture to more than 9,000 famers' households, which is more than twice as much as the planned objective number. Hence, Cambodia government appreciated the project outputs; then, it requested FAIEX-2 for the north-western region, where the poverty level is much higher. Japan International Cooperation Agency (JICA) dispatched the detail project planning studies twice at the ends of May 2010 and September 2010 to discuss with relevant governmental officials of the Cambodia side, such as Fisheries Administration, and determined the project framework. The R/D of the project, Freshwater Aquaculture Improvement and Extension Project Phase-2, was concluded on January 10, 2010. The project is implemented in 4 years from the middle of March 2011 in collaboration with Fisheries Administration (FiA), Ministry of Agriculture, Forestry and Fisheries, Cambodian Government, as a counterpart (C/P) agency.

[1] Recent data from FiA at the moment of the Terminal Evaluation
[2] Idem

Chapter 2: Methodology of the Terminal Evaluation

2-1. Process of the Evaluation Study

In accordance with the Evaluation Guideline of JICA, the Terminal Evaluation was conducted based on the methodology of Project Cycle Management (PCM), on the basis of actual PDM (version 2) revised in February 2013. The following steps were taken in the Evaluation Study.

1) Prepare the Evaluation Grid and agree on the design of the Evaluation.
2) Collect information necessary for the Evaluation.
3) Assess the performance of the Project in reference to the PDM version 2 and R/D.
4) Review the implementation process of the project activities and factors that promoted or inhibited the progress of the Project.
5) Analyze the Project as a whole based on the five (5) evaluation criteria.
6) Identify recommendations and lessons learned from the analysis.
7) Have a discussion about the results of the Evaluation and the future directions of the Project.
8) Agree on the Terminal Evaluation Report by both Cambodian and Japanese stakeholders.

The data and information necessary for the Evaluation were gathered by means of the following methods, and from the following sources.

Table 2-1: Methods and sources of information collection

Methods	Sources
Document Review	• Project Formulation Report and R/D • Midterm Review Report • Progress Reports • Document prepared by the Project for the Terminal Evaluation • Policy documents of Cambodian Government • Other related documents
Questionnaire	• C/P personnel of FiA at cantonment level • Fish Seed Producers (FSPs) of the Project
Interview	• Project Director and Manager of FiA • C/P personnel of FiA • Japanese Experts • FSPs and small-scale fish farmers involved in the Project • People involved in the Community Fish Refugee (CFR) activities in the target communes

2-2. 5 (Five) Evaluation Criteria

The criteria of the analysis used for above mentioned Step 5 are as described in the Table 2-2 below.

Table 2-2: Evaluation Criteria

Criteria	Description
Relevance	The extent to which the aid activity is suited to the priorities and policies of the target group, recipient and donor. In evaluating the relevance of a programme or a project, it is useful to consider the following questions: ● To what extent are the objectives of the programme still valid? ● Are the activities and outputs of the programme consistent with the overall goal and the attainment of its objectives? ● Are the activities and outputs of the programme consistent with the intended impacts and effects?
Effectiveness	A measure of the extent to which an aid activity attains its objectives. In evaluating the effectiveness of a programme or a project, it is useful to consider the following questions: ● To what extent were the objectives achieved / are likely to be achieved? ● What were the major factors influencing the achievement or non-achievement of the objectives?
Efficiency	Efficiency measures the outputs -- qualitative and quantitative -- in relation to the inputs. It is an economic term which signifies that the aid uses the least costly resources possible in order to achieve the desired results. This generally requires comparing alternative approaches to achieving the same outputs, to see whether the most efficient process has been adopted. When evaluating the efficiency of a programme or a project, it is useful to consider the following questions: ● Were activities cost-efficient? ● Were objectives achieved on time? ● Was the programme or project implemented in the most efficient way compared to alternatives?
Impact	The positive and negative changes produced by a development intervention, directly or indirectly, intended or unintended. This involves the main impacts and effects resulting from the activity on the local social, economic, environmental and other development indicators. The examination should be concerned with both intended and unintended results and must also include the positive and negative impact of external factors, such as changes in terms of trade and financial conditions. When evaluating the impact of a programme or a project, it is useful to consider the following questions: ● What has happened as a result of the programme or project? ● What real difference has the activity made to the beneficiaries? ● How many people have been affected?
Sustainability	Sustainability is concerned with measuring whether the benefits of an activity are likely to continue after donor funding has been withdrawn. Projects need to be environmentally as well as financially sustainable. When evaluating the sustainability of a programme or a project, it is useful to consider the following questions: ● To what extent did the benefits of a programme or project continue after donor funding ceased? ● What were the major factors which influenced the achievement or non-achievement of sustainability of the programme or project?

Source: http://www.oecd.org/dataoecd/15/21/39119068.pdf

Chapter 3: Performance and Implementation Process

3-1. Input

3-1-1. Input from Japanese Side

The following inputs were provided by Japanese side as of July 2014. For more details of each input, refer to Annex 5: List of Inputs from Japanese Side.

(1) Experts

7 experts in 6 fields of expertise; 1) Team Leader/ Aquaculture extension/ Feed Development, 2) Deputy Team Leader/Aquaculture extension II/Training I, 3) Seed production/ Broodstock management, 4) Aquaculture facilities and equipment, 5) Community fish refuge pond, and 6) Coordinator/Training II, have engaged in the project activities during the project period. As of July 2014, the total Man/Month (M/M) of the assignment is 78.1.

(2) Training of C/P personnel in Japan and/or the Third Countries

[Training in Japan]

2 C/P personnel participated in a training course "Observation Tour on Fisheries/ Aquaculture" in Japan in 2012.

[Training in Third Countries]

The training and study tour in Indonesia or India (Freshwater Aquaculture Technique / Observation Tour on Aquaculture) was conducted 3 times, once a year from 2011 to 2013, and 44 C/P personnel and FSPs in total participated in it. In addition, 4 C/P personnel and 1 FSP participated in an International Symposium on Small-Scale Freshwater Aquaculture Extension in Thailand in 2013.

(3) In-country training

Various types of training were realized during the Project Period, targeted at C/P personnel, FSPs and small-scale fish farmers, including the following training conducted every year from 1st to 4th year of the project period.

- For C/P members: "Training for local extension staff (in grow-out and seed production, or PCM workshop)"
- For FSPs: "Training for FSPs (in seed production techniques)", "Trainers' Training for FSPs on the Farmer to Farmer (FTF) Training", "Brush-up Training for Seed Producers" and "Workshop on the feedback of study tour".
- For small-scale fish farmers: "FTF Training (in grow-out techniques)", and "Workshops of fish farmer meeting"

In total, 33 C/P members (incl. 6 inactive), 44 FSPs and 3,425 small-scale fish farmers received at least one of the training provided by the Project.

(4) Facility improvement of the Toek Vil Fish Seed Production Station

The facilities including a water intake and discharge system, fishponds and dike, an office building and laboratory, a deep well, feed preparation facilities, and electricity line, were restored in Toek Vil Seed Production Station in the first and second year of the Project. The total cost was 55,774 US dollars.

(5) Provision of machinery and equipment

The machinery and equipment worth approximately 220,682 US dollars[3] were provided, including 14 motorbikes, 2 4WD vehicles, office equipment and laboratory and hatchery equipment.

(6) Local expenses for the project activities

An amount of approximately 1,235,035 US dollars[4] was spent for project activities up to the end of July 2014. The total amount of local expenses by the end of the project period will be 1,369,979 US dollars[5].

3-1-2. Input from Cambodian side

(1) Personnel

Since the beginning of the Project, Director General of FiA, Director of DAD and Deputy Director of DAD have been assigned as Project Director, Project Manager, and Deputy Project Manager respectively. In addition, 6 staff members of FiA at central level have been assigned for the project activities. As to the cantonment level, 4 staff members have been assigned for Pursat, 7 for Battambang, 4 for Siem Reap, and 4 for Toek Vil Seed Production Station. The total number of C/P personnel is 28 at the moment, including 4 staff members added after the Midterm Review. During the 2nd half of the project period, 3 members were replaced (1 relocated and 2 passed away).

(2) Provision of the project offices and facilities necessary for the project implementation

The project office has been provided in the building of FiA in Phnom Penh. Also the Toek Vil Seed Production Station has been utilized for the implementation of project activities.

(3) Expenses for the construction and development of aquaculture ponds

[3] The costs spent in Japanese Yen (JPY) was converted into US dollars using the average JICA's exchange rate for Japanese Fiscal Year (JFY) 2011: 1 US$=78.89 JPY, JFY 2012: 1US$=82.28 JPY, and JFY 2013: 1US$=99.61JPY.

[4] Converted with the average JICA's exchange rate for JFY 2011: 1 US$ = 78.89 JPY, JFY 2012: 1US$=82.28 JPY, JFY 2013: 1US$=99.61 JPY and JFY2014 up to July: 1US$ = 102.62 JPY.

[5] Idem

In 2011 about 1,000 fish ponds were constructed in Pursat Province by the Cambodian Government, through the collaboration of FiA, Ministry of Industry, Mining and Energy and Pursat Provincial Government.

(4) Others

The running costs for electricity, water, internet, etc. for the project office were born by Cambodian Side.

3-2. Achievement of Outputs and Project Purpose

3-2-1. Achievement of Outputs

(1) Output 1: Small-scale seed production and grow-out technology is improved.

In the Output 1, firstly the Project identified issues and challenges on small-scale seed production and grow-out technology for the farmers in the target provinces through the monitoring of the activities and evaluation meetings, and then conducted technical improvement on the items shown in the Table 3-1 at the Toek Vil Fish Seed Production Station. Also, some verification trials on the new techniques and experiments on rice-cum-fish culture were undertaken at selected FSPs and small-scale fish farmers. As a result, various improved technologies were identified and adopted in the technical manuals, as described in the Table 3-2. Also, the technical improvement was confirmed by the improvement of survival rate and breeding operation at FSPs. It is considered that necessary techniques for target species in both seed production and grow-out were developed sufficiently.

Table 3-1: Technical Experiment on Seed Production at Teok Vil Station

Target Fish Species	Issues	Items of Verification Experiment
Silver barb Silver carp Indian carp (Mrigal)	Spawning	• Effect on spawning by hormone application – Compare effects by several kinds of hormones – Compare effects by expiration date and brand (origin countries) – Compare effects by hormone injection methods and volume of injected hormone. – Compare effects on spawning interval time and quantity of spawned eggs (by broodstock size) by practices indicated above. • Effect on spawning by different designs of spawning tanks (shape and volume) • Effect on spawning by water quality (aeration, water change rate, water flows)
	Hatching	• Estimation of proper volumes of stocked eggs by shape of hatching tanks and stocking densities of fertilization eggs in tanks • Causes of mass death at hatching stage by observation (water change rate, water flow, and removal timing and method of dead or

		unfertilized eggs)
Tilapia	Mono-sex (all male)	• Arrangement of feeds mixed with hormone – Consideration of proper feed types (local feed materials, commercial crumble compounded feeds) – Making trails of proper feeds by existing skills • Collection method of tilapia seeds • Culture environment (comparison of effective feeding conditions) • Feeding methods (feeding frequency, amount of feeds)

Table 3-2: Achievement of Indicators for Output 1

Indicators	Achievement
1-1. The number of the technical improvements through experiments is increased	• Through the experiments at Toek Vil Station, the techniques were improved on the following issues/items. These technical improvements were included in the technical manual. – Stocking density and feeding – Main and secondary feeds – Removing of wild fish and prevention of predator fish – Flood countermeasures – Hormone application – Spawning by stripping method – Identification of the ovary maturation of broodfish by Cannula insertion – Rice-cum-fish culture
1-2. The degree of the technical improvement, such as growth rate and survival rate, is improved.	• The survival rate identified through the experiments in Toek Vil Station in 2012 as the baseline data was less than 1% for Silver barb and Mrigal[6]. The results of seed production trials by improved technical management in 2013-2014 showed that the survival rate was 16% for Silver barb and 7% for Mrigal[7]. • Regarding the number of success in breeding operation at FSPs, which was considered as an indicator of technical improvement at the moment of Midterm review, it was observed that the breeding operation for all target species except Silver carp was successfully done almost every time by majority of farmers except new FSPs. As to Silver carp, the success in breeding operation still varies among FSPs. After the trials, it is considered that the water quality and size of broodstock are critical factors for success.

(2) Output 2: Capacity of local aquaculture extension services is enhanced.

The Project intended to enhance the capacity of C/P staff members who provide local aquaculture extension services in the 3 target provinces during the project period, through the training and daily activities of the Project. As a result, the capacity of C/P staff members for local

[6] The data of 108 days after hatching for Silver Barb and 79 days for Mrigal (source: monthly report of experts in November 2012, supplemental remarks).

[7] The data of 60 days after hatching for Silver Barb and 46 days for Mrigal (source: monthly report of experts in August 2014, supplemental remarks).

aquaculture extension services in general is considered strengthened, as described in the Table 3-3. At the same time, the results of recent assessment showed that the capacity in some items, such as the seed production of Silver carp and Mrigal, has not reached to the adequate level.

Table 3-3: Achievement of Indicators for Output 2

Indicators	Achievement
2-1. 80% of the C/P extension staff gains capacities to conduct extension activities on grow-out and seed production technology properly.	• The number of target C/P staff members was 19 at the moment of Terminal Evaluation. The level of capacities of 18 staff members out of the 19 target members to conduct extension activities was assessed in August 2014, using the assessment tool (self-evaluation)[8] developed and used at baseline in 2011. As shown in the Table 3-4, only 38% of C/P staff members scored satisfactorily (4 point out of 5 or higher) before the intervention of the Project (baseline), and 86% of them scored satisfactorily in the recent assessment. • While the average score among the 11 technical items of the assessment was 3.46 at baseline, it was 4.21 in the recent assessment, as shown in the Table 3-5. It was identified that there are 2 technical items lower than 4.00, such as seed production of Common carp and seed production of Mrigal.
2-2. Satisfaction ratings of the FSPs attain to more than 80% on average regarding the teaching capability of local extension staff.	• According to the results of a questionnaire survey done by the Project in August 2014[9], 100% of FSPs answered that the services provided by extension officers were "Very good" in terms of "technical advices" and "facilitation for organizing farming communities or networks", and 94% answered "Very good" in terms of "communication with farming communities" (6% answered "Good").

Table 13-4: The score of capacity assessment of C/P staff members (extension officers)

Average score	Number of C/P staff and percentage			
	Baseline (2011) *		Actual (August 2014)	
1.0 – 1.9	2	13%	0	0%
2.0 – 2.9	4	25%	1	6%
3.0 – 3.9	4	25%	4	25%
4.0 – 5.0	6	38%	12	86%

* Including the 2 staff members who became C/P staff in 2013 (at the moment of baseline, these 2 staff members received the assessment as non-C/P staff member of FiA).

[8] The tool has 11 technical items which are necessary to be covered to provide extension services in grow-out and seed production. Each of the items are assessed by C/P themselves using a set of criteria from A (higher) to E (lower), and the results are converted into the score from 1 to 5. 4 is the passing score to be considered that the capacities are adequate.

[9] Among the 39 active FSPs in this year, 32 (82.1%) FSPs were covered in this survey

Table 3-5: Average score marked by C/P staff members (extension officers) by items

	Technical Items	Average score	
		Baseline (2011)*	Actual (August 2014)
1	Seed production: Silver barb	3.56	4.17
2	Seed production: Common carp	3.38	4.11
3	Seed production: Silver carp	2.69	3.28
4	Seed production: Mrigal	2.81	3.89
5	Seed production: Tilapia	3.38	4.56
6	Broodstock culture	3.31	4.22
7	Nursering of fish fries	3.25	4.00
8	Feeding management	3.63	4.11
9	Pond preparation	4.25	4.83
10	Fertilization of fish pond	4.25	4.83
11	Record taking of fish culture	3.56	4.33
	Average	3.46	4.21

* Including the 2 staff members who became C/P staff in 2013 (at the moment of baseline, these 2 staff members received the assessment as non-C/P staff member of FiA).

(3) Output 3: Seed farmers are capacitated.

In order to capacitate the FSPs, the Project selected farmers who have potential, in terms of investment, facilities, environmental conditions, labor supply, and willingness to engage in FTF extension, to become independent FSPs after the intervention of the Project. For those selected farmers, the Project provided 1) technical training (in-country and third country), 2) in-kind assistance such as facility, broodstock etc. and 3) on-farm technical guidance. As described in the Table 3-6, the numerical target was achieved in terms of the number of FSPs, although some of them are inactive due to their personal and family reasons. As to the capacities of seed production, while all FSPs, except 3 farmers who started from 2014, are considered to have technical capacities to produce at least 3 species, there is variability among FSPs in the survival rate at nursing stage due to the various conditions required. Regarding the amount of seed production and sales income, the damages caused by flooding and lack of rainfall affected negatively every year during the project period in target provinces.

Table 3-6: Achievement of Indicators for Output 3

Indicators	Achievement
3-1. The number of FSPs producing fingerlings is increased from 19 farmers to 40 farmers in target areas.	• As shown in Table 3-7, the total number of FSPs who are selected and trained through the project activities was 44, including the newly involved 3 farmers from 2014. Among the 44, 4 farmers are inactive due to their personal and family reasons.
3-2. The number of FSPs who can	• The seed production techniques required for 3 species (Silver bard, Common carp and Tilapia) are considered basic skills for FSPs which can

produce seed of at least three species is doubled in target areas.	be applied to produce different species. While 10 farmers had produced seeds of 3 or more species at baseline, 22 FSPs produced more than 3 species, according to the production record up to 2013. • Even if they have technical capacities to produce more than 3 species, the number of species produced by each FSP varies in fact depending on their preference, availability of broodstocks, water and facilities, and sales strategy. As reported by experts, all FSPs gained skills to produce seeds of at least three species, according to the observation of their capacities in the "Brush-up Training for Seed Producers". • On the other hand, it is considered that the survival rate at nursing stage varies among FSPs. It requires experiences and various conditions in the production circumstance, including the feeding, water quality and quantity, presence of predators or inspects, etc.
3-3. The amount of seed production by FSPs is doubled.	• The total amount of seeds produced by small-scale FSPs identified at baseline was about 1,472,000 in 2010 according to the survey done by the Project. As shown in the Table 3-8, the amount of production reached up to 3,248,500 in 2013. Therefore, the amount of seed produced was doubled from the baseline data. However, 767,500 seeds were lost by flooding, and the ultimate production of seed was 2,481,000. • The severe damages of extreme weather which occurred every year during the project period affected negatively the amount of production in all 3 target provinces. Especially, the loss of broodstocks due to the flooding caused negative effects on the production of fingerlings, since sometimes it is difficult for farmers to obtain good quality broodstocks and they have to suspend their production until the broodstocks grow mature. The lack of water in early rainy season (May to August) also affected seriously the amount of production, since it is the breeding season of 4 target species (except Tilapia).
3-4. Sales income of the FSPs is doubled in target areas.	• Provided that there is no decline of the seed price, the sales income is considered to be increased if the amount of production is increased. However, as shown in the Table 3-8, the amount of sales in Pursat and Battambang did not increase as much as expected, comparing the figures in 2011 and 2013, while in Siem Reap the number of seed produced was almost doubled from 2011 to 2013, and so as the number of seed sold. • It is considered that the volume of sales was also affected negatively by extreme weather. The lack of rainfall in early rainy season stopped grow-out farmers from buying fingerlings to start or continue fish farming. And previous experiences of flood damages discouraged glow-out farmers from starting or restarting fish farming.

Table 3-7: Number of FSPs trained by the Project
(Number of farmers who abandoned the seed production after the training)

Target Provinces	2011	2012	2013	2014	Total
Pursat	4 (-1)	5 (-1)	5	2	16 (-2)
Battambang	6 (-1)	5	5	1	17 (-1)
Siem Reap	4	6 (-1)	1	0	11 (-1)
Total	14 (-2)	16 (-2)	11	3	44 (-4)

Table 3-8: Amount of seed production and sales by FSPs

Target Provinces	2011		2012		2013		
	Produced	Sold	Produced	Sold	Produced	Lost by flooding	Sold
Pursat	749,000	652,968	305,000	248,288	539,500	30,000	401,700
Battambang	907,645	883,745	1,331,600	907,500	1,876,200	718,000	836,700
Siem Reap	436,325	349,730	464,200	373,500	832,800	19,500	710,900
Total	2,092,970	1,886,443	2,100,800	1,529,288	3,248,500	767,500	1,949,300

(4) Output 4: Small-scale aquaculture is expanded in the target provinces.

In order to expand small-scale aquaculture in the target provinces, the Project provided 1) Trainers' training for FSPs to give training on grow-out practices for small-scale fish farmers, 2) FTF training from FSPs to potential small-scale fish farmers who are qualified with the criteria, such as willingness, availability of ponds and water, distance from a FSP, accessibility to the necessary agricultural materials, and support from his/her family members, 3) in-kind assistance such as fingerlings (up to 500) and hapa net or screen net for those who participated in the FTF training, 4) monitoring and technical assistance through on-firm guidance and evaluation meeting, and 5) supports to selected CFRs, including the provision of equipment to prepare and maintain the ponds and broodstocks to release in the ponds, the preparation of facilities such as fish pathways and sign board, and guidance to prepare management rules of the CFR and to manage it in accordance with the rules. As described in the Table 3-9, the number of farmers who benefitted from FTF training exceeded 3,000 households by the 4th year of the Project. Also, the CFRs are well recognized by community members and managed mostly in accordance with their regulations in all 4 sites.

Table 3-9: Achievement of Indicators for Output 4

Indicators	Achievement
4-1. The number of small-scale fish farmers benefitted from farmer-to-farmer training attains to more than 3,000 households in target areas.	• The total number of farmers who participated in the FTF training reached up to 3,425 by the 4th year, as shown in Table 3-10.

4-2. The 4 target community fish refuges (CFRs) are properly managed in accordance with their regulation.	• In the selected 4 CFRs sites, each group of villagers established their regulation based on a model guideline prepared by the Project. • According to the monitoring of the activities in each site, the CFRs were recognized by majority of community people, and managed mostly in accordance with the regulation in all 4 target sites. • In 2 target sites, there were some incidents of illegal fishing, but community members properly responded to these cases with the assistance of FiA cantonment office and police.

Table 3-10: Number of farmers participated in FTF training (Plan and Actual)

Target Provinces		2011	2012	2013	2014	Total
Target number (Plan)		375	750	1,125	1,125	3,375
Actual number	Pursat	135	256	377	329	1,097
	Battambang	250	391	383	373	1,397
	Siem reap	120	250	331	230	931
	Total	505	897	1,091	932	3,425

(5) Output 5: Networks of seed farmers are enhanced and broadened.

As a first step to establish the networking among the FSPs, the Project facilitated FSPs to establish a provincial network, and to strengthen cooperation among FSPs in each target province. Also, the Project promoted cooperation among the networks of FAIEX-2 and FAIEX-1 to enhance the collaborative relationship among FSPs in the country. As described in the Table 3-11, the network in each province is functioning independently, under the mutual collaboration of farmers depending on their needs, exchanging information about seed production techniques, seed marketing, availability of broodstocks, among others, not only through the meetings but also more frequent communication by mobile phone and exchange visits.

Table 3-11: Achievement of Indicators for Output 5

Indicators	Achievement
5-1. The meetings for information exchange on seed production technology, seed marketing, etc. are convened 2 times per year.	• The Project organized meetings of FSPs' network more than twice every year in each target province since the 2nd year of the project period. • In addition to these meetings organized by the Project, there was a training arranged by FSPs themselves in each target province, getting the technical support from the Project. • The network of each province is planning to hold regular meetings by themselves, although it has not been realized yet. • Also, in addition to the meetings, some FSPs communicate each other closely by mobile phone upon their necessity.
5-2. The number of advices and recommendations regarding seed production technology, seed marketing, procurement	• Through the meetings mentioned above and other means of communication among the FSPs, they have been exchanging information in seed production technology, seed marketing, procurement of farm inputs, availability of broodstocks, and

of farm inputs, etc. is increased in target areas.	so on. Given that the function of network has been strengthened, the number of advices and recommendations has increased in target areas.

3-2-2. Achievement of Project Purpose

Project Purpose:	Small-scale aquaculture production is increased in the target provinces
Indicator:	Annual production of small-scale aquaculture promoted by the Project is increased up to 150 tons in target areas in 2015.

The targeted value "150 tons" of the indicator was derived from the estimation shown in the Table 3-12.

Table 3-12: Estimated aquaculture production of small-scale farmers by 2015

Number of small scale farmers	% of farmers continuing fish culture	Supposed pond side	Productivity ($kg/100m^2$)	Aquaculture production by small-scale farmer
3,375 x	80% x	120 m^2 x	35kg/100m^2	= 113 ton
3,375 x	80% x	120 m^2 x	40kg/100m^2	= 130 ton
		≀	≀	≀
3,375 x	80% x	150 m^2 x	35kg/100m^2	= 142 ton
3,375 x	80% x	150 m^2 x	40kg/100m^2	= 162 ton

The actual situations in each of these items used for the estimation have been identified as followings;

1) Number of small-scale farmers:

The number of small-scale farmers who participated in the FTF training was 3,425, as described in the Achievement of Output 4.

2) Percentage of farmers continuing fish culture:

According to the result of questionnaire survey conducted by the Project every year in the "Workshops of fish farmer meeting" intended for grow-out farmers who started fish culture from previous year, every year more than 90 % of farmers answer that they plan to continue fish farming in the following year. However, the actual number of farmers who continue fish farming was considered lower, due to the flood damages and the lack of rainfall during the project period. According to the C/P officers of each target provinces, they observe that roughly 60-70% of them are continuing grow-out of fish. On the other hand, according to the results of Impact Survey, 91% (n=118) of fish farmers have more than 1 year experience in grow-out, and it can be assumed that majority of farmers engage in grow-out continuously or intermittingly. Also only 11 % plan to stop the aquaculture activity in the future due to the lack of land, financial

resource, labour, and water, or the migration to work outside the village. Therefore, it can be presumed that the 80% of retention rate would be possible to achieve if climate permits.

3) Supposed pond size:

According to the Project, the mean dimension of earthen ponds of small-scale farmers who participated in the FTF training was 219 sq.m. as shown in the Table 3-13. Also, the result of Impact Survey revealed that the average side of pond for fish production was 186 sq.m (n=122). Therefore, the size of pond in the target area for fish production seems larger than the supposed pond size.

Table 3-13: Average size of earthen ponds of small-scale farmers (sq.m./household)

Target Provinces	2011	2012	2013	Total mean
Pursat	121 (n=140, mode: 100-150)	183 (n=253)	173 (n=377, mode:100-150)	167
Battambang	235 (n=258, mode: 100-150)	403 (n=298)	256 (n=411, mode: 100-150)	296
Siem Reap	223 (n=127, mode: 100-150)	149 (n=246)	167 (n=338, mode: 150-200)	171
Total mean	202	255	201	219

4) Productivity:

According to the follow-up survey conducted by the Project with fish farmers who started their production in the previous year, the average amount of production was 35.4kg/100sq.m. (n=28)[10] in the 1st year of the project period, and 30.8kg/100sq.m. (n=17)[11] in the 2nd year. It is assumed that the productivity of the 2nd year of their production would be higher than these figures. Therefore, the productivity in the target areas of the Project is considered in the similar range as that of FAIEX-1 (30-40kg/100sq.m.).

Above all, the current amount of production can be estimated as shown in the Table 3-14. Except a case of which assumes the continuity of grow-out farmers as 60% and the productivity as 30 kg/100m^2, the amount of production is considered higher than the numerical target of the indicator of the Project Purpose. Therefore, it is highly likely to achieve the Project Purpose.

[10] The data was gathered in August 2012 from randomly selected 28 farmers (from 10 different communes) who started fish farming from the previous year. At the moment of the investigation, most of farmers had totally harvested their production.

[11] The data was gathered in July 2013 from randomly selected 36 farmers (from 12 different communes) who started fish farming from the previous year. At the moment of the investigation, 17 farmers out of the 36 farmers had totally harvested their production.

Table 3-14: Estimated aquaculture production of small-scale farmers as of August 2014

Number of small scale farmers trained	Supposed % of farmers continuing fish culture	Average pond side	Average productivity (kg/100m^2)	Aquaculture production by small-scale farmer
3,425 x	60% x	219 m^2 x	30 ~ 35	= 135 ton ~ = 158 ton
	70% x		30 ~ 35	= 158 ton ~ = 184 ton
	80% x		30 ~ 35	= 180 ton ~ = 210 ton

3-2-3. Prospects to achieve Overall Goal

Overall Goal:	Household economy of small-scale fish farmers are improved in the target provinces.
Indicator:	The number of small-scale fish farmers with increased profits*1 and savings*2 from fish farming is increased by 5,000 households in target areas by 2018.

*1 "Profit" is given by subtracting "production cost" from "fish sales income of cultured fish."
*2 "Saving" is given by self-consumption of cultured fish, which would otherwise be expenses for purchase of fish in the market, i.e., by subtracting "present cost to purchase fish" from "previous cost to purchase fish."

According to the results of Impact Survey, more than 63 % (n=122) of fish farmers raise fish mainly for family consumption, and nearly 28 % for both consumption and selling in the target provinces. Therefore, it is assumed that fish farmers increase savings, or both profits and savings.

As described in the achievement of Output 4, the Project identified 3,425 farmers and provided training to start fish farming. Estimating that around 80% of farmers continue grow-out, it is assumed that there are 2,740 farmers continuing fish farming so far if climatic conditions permit. In order to achieve the indicator of the Overall Goal, it is necessary to extend the small-scale aquaculture to at least 3,510 new farmers by 2018 considering the retention rate. Although it is difficult to know the exact number of customers (grow-out farmers) who bought fingerlings from FSPs since they do not record the number of customers nor volume of sales, according to the 11 FSPs interviewed by the Terminal Evaluation Team, the number of new non-target customers varied in each farmer, and many of them have sold fingerlings to 10 to 20 new non-target farmers, while one of them sold to more than 50 new farmers, and another sold to more than 100 new farmers, without project support.

It was also confirmed with interviewed FSPs that they provided technical instruction to the new farmers who did not have enough technical capacities on grow-out, because they consider it as a strategy to retain the customer. They understand that the successful grow-out production for the 1st year is necessary to get the customers to return to buy fingerlings from them. Such It will continuously contribute to maintain the persistence rate of grow-out farmers.

Also note that the past data on the number of non-target farmers/buyers who bought fingerlings from FSPs, including those who were the target farmers of FTF training in the previous year, has been fluctuating, as shown in the Table 3-14, although the total number of farmers who were supplied fingerlings from FSPs increased with the increasing number of target farmers of FTF training. It is considered mostly because of the influence of flooding and lack of water, which has made it quite difficult to understand the market tendency and demand of fingerlings from small-scale farmers based on the data and experiences of past 3 years.

Table 3-14: Number of farmers/buyers supplied seeds from FSPs

Target Provinces	2011			2012			2013		
	Target of FTF*	Non-target**	Total	Target of FTF*	Non-target**	Total	Target of FTF*	Non-target**	Total
Pursat	135	360	495	256	223	479	377	232	609
Battambang	250	402	652	391	575	966	383	633	1,016
Siem Reap	120	148	268	250	7	257	331	105	436
Total	505	910	1,415	897	805	1,702	1,091	970	2,061

* The target farmers of FTF training who receive fingerlings (up to 500) free of charge from the Project. The Project buys the fingerlings from FSPs of the Project.

** The non-target farmers, middleman as well as NGOs/donors who bought fingerlings from FSPs, including those who were the target farmers of FTF training in the previous year.

3-3. Implementation Process

(1) Implementation of the activities

The work plan was examined every year in accordance with the original plan and achievement of previous years, and modified as needed in order to implement necessary activities smoothly. Some activities were implemented ahead of schedule, including the restoration work of facilities in Toek Vil Station, the preparation of Community Fish Refuge Ponds, and the selection of FSPs and their preparatory activities, and some activities were newly added to the original plan, including the excavation of fish ponds for small-scale fish farmers, the workshop of fish farmer meeting to enhance their capacities and continuity, and the promotion of rice-cum-fish culture. Also, considering the circumstances of the moment, the Project Team (C/P members and Japanese experts) implemented the activities flexibly including the cases when some countermeasures were required, such as unexpected damages of flood and a lack of necessary facilities and materials for the production for farmers. Especially, the Project activities were heavily affected when serious damages were caused by flooding in 2011 and 2013.

(2) Management and communication

The meetings of Joint Coordinating Committee (JCC) were held once a year (3 times in total so far), as determined in R/D, to discuss the results and progress of the Project annually. At the operational level, the Project Manager convened monthly meeting with the participation of C/P staff

members at central and each target province, in order to monitor the progress and discuss related issues to secure the smooth implementation of the activities. According to the C/P staff members, the communication among the Project Team, including FiA Central and Cantonment offices as well as Japanese experts, was adequately maintained for the smooth implementation of project activities.

(3) Technical Transfer

The technical transfer to C/P staff members, FSPs and small-scale fish farmers was realized mainly by means of various in-country training, third country training, daily extension activities, on-farm guidance, and exchange visits and experiences. According to the C/P staff members, the methodologies of training for each actor were mostly excellent, and each actor has gained capacities to carry out his/her corresponding activities, although new FSPs and fish farmers will need more experience and some technical support. Many of C/P members mentioned the effectiveness of the third country training both for C/P members and FSPs to gain new techniques and technical knowledge.

(4) Allocation of human resources

After the Midterm Review, 4 additional C/P staff members were allocated in conformity with the volume of work required to extend the number of fish farmers. FiA answered flexibly to the request, and the extension activities in 3 target provinces were accommodated in a more adequate manner. According to the C/P staff members, the contribution of each actor of the Project Team, including FiA Central, Cantonment offices, and Japanese Experts, was excellent.

(5) Revision of PDM

The PDM was revised twice during the project period. Firstly the indicators which had been left blank in their target value were updated with the results of baseline survey and additional investigations in February 2012 (PDM ver. 0 to ver. 1), and secondly some indicators were modified to match the actual situations following the recommendations given by the Midterm Review in February 2013 (PDM ver. 1 to ver. 2). Both revisions were agreed among stakeholders in the JCC meetings.

(6) Follow-up activities of the recommendations raised by the Midterm Review

After the Midterm Review, the following actions were taken considering the recommendations given by the Review Team.

Table 3-14: Actions taken as follow-up of recommendations

Recommendations	Actions taken
(1) **The target number of FSPs**: Decrease the target number of FSPs in accordance with the actual conditions, and select only qualified farmers who can produce seeds without fail and provide FTF training adequately.	The target number of FSPs was decreased to 40 after the Midterm Review, considering the lack of qualified candidate farmers to assure the sustainability in the target areas. The selected farmers fulfilled all the conditions to be FSPs at the moment of selection.
(2) **Strengthening extension services to fish farmers**: Increase the number of C/P personnel and strengthen the extension services, and consider necessary assistance in the construction of farmers' facilities.	4 C/P members were added after the Midterm review. Also the Project provided materials necessary for the construction of facilities to the FSPs who started seed production recently.
(3) **Promotion of small-scale aquaculture with focus on rice-cum-fish culture**: Study methods on how to increase the number of rice-cum-fish farmers.	A guidebook and a video material on rice-cum-fish culture were prepared by the Project Team in order to accelerate the extension. Also, the Team established additional demonstration firms to enhance the access to them, and conducted experiments to identify adequate conditions of the production.
(4) **Linkage between technical improvement and extension**: Establish a system in which both the extension officers and the station officers often interact and exchange information in order to solve technical issues for FSPs, such as low survival rate of larvae and lack of quality brooders among others.	The technical issues observed by C/P extension officers were shared and discussed in the Project Team, and reflected in the experiments in Toek Vil Station and on-firm guidance or brush-up training. Many trials were done at FSPs with supports of C/P officers.
(5) **Proper Management of Non-target fish species by FSPs**: Provide some technical information on clarias and pangasius to the farmers, and guide clarias seed producers about the proper management of African brooders.	The Project Team provided technical information about the concerned species and the adequate management of African brooders to FSP in on-firm guidance and brush-up training.
(6) **Revision of PDM indicators**: Review some of the indicators of Outputs of the PDM version 1.	Some indicators were modified and the PDM was revised soon after the Midterm Review.

Chapter 4: Results of the Evaluation

4-1. Evaluation by 5 (Five) Criteria

4-1-1. Relevance

(1) Needs of Cambodian rural communities and target areas

The 3 target provinces of the Project are located distant from Mekong River system, where there are many farmers with economic difficulty. In the inland areas away from Tonle Sap Lake, the supply of fish is insufficient as a source of protein. The freshwater aquaculture is, therefore, considered as a potential means for food security and livelihood in the areas, as it can be undertaken in parallel with rice cultivation. It was identified that technical skills and seed supply were insufficient in the areas to increase the aquaculture production at the moment of the formulation of the Project, and such needs of the target provinces have remained unchanged. Also, in the target provinces people conventionally catch fish from surrounding ponds, paddy fields, etc. for their domestic consumption, however, the availability of wild fish has been decreased year by year according to the farmers, and more farmers are interested in the aquaculture as an alternative means to obtain fish. Therefore, the Project is still consistent with the needs and actual situations of the target areas.

(2) Policy of the Cambodian Government

In the revised National Strategic Development Plan: NSDP (2014-2018), "Promotion of Agricultural Sector" remains as one of the prioritized areas, which includes the promotion of aquaculture. In particular, it mentions that the Government will continue to implement measures aimed at ensuring sustainability of both freshwater and marine fishery resources, focusing on the further implementation of Strategic Planning Framework for Fisheries 2010-2019 with the aim of boosting fish production to serve domestic consumption and export markets. The monitoring indicator for this area is set to 15% annual increase of aquaculture production.

According to the Strategic Planning Framework for Fisheries: 2010- 2019, one of the key areas for strategic intervention to the issues facing in the fishery sector is "to support the growth of small, medium and large-scale freshwater aquaculture".

In addition, The National Aquaculture Development Strategy was promulgated in February 2014, and the Project is consistent with the Strategy in some of the objectives, such as "Increase quality, quantity and diversity of seed available for farmers", and "Improve efficiency, profitability and sustainability of aquaculture production through increased knowledge and organization".

Therefore, it was confirmed that the Project remains consistent with the Policy of the Cambodian Government.

(3) Japanese Official Development Assistance (ODA) policy

The Japanese country assistance policy for Cambodia (April 2012) has not been changed since the Midterm Review, which aims at steady and sustainable economic growth and balanced development. In one of the pillars of priority "strengthening of the basis for economic activities", there is a cooperation program on the agriculture and rural development, and it intends to enhance agricultural productivity as a whole and livelihood of rural farmers by means of diversifying agricultural production including the aquaculture as one of the strategies.

(4) Suitability as means

The Project is designed to apply the experiences of FAIEX-1 to other areas in the country with different conditions. The "Farmers to Farmers" training which has been applied in the project activities was verified in the FAIEX-1 as an adequate method to extend the aquaculture to small-scale farmers, and it is highly recognized in the FAIEX-2 too, taking account of the budgetary constraints of the Government for the extension. The 3 target provinces were selected considering the regional characteristics such as the volume of precipitation, geographical and geological conditions etc. For the selection of FSPs, target communes, target small-scale fish farmers and CFRs, some criteria were established to select them adequately, considering the smooth implementation of the activities. Therefore the approach and means of the Project are considered adequate to contribute to the promotion of aquaculture in the rural areas.

(5) Collaboration and demarcation with other donor interventions

In the target areas of the Project there are some interventions related to the freshwater aquaculture, such as the Harvest programme of United States Agency for International Development (USAID) and other projects of local Non-Governmental Organizations (NGOs). There was coordination with these projects in order to separate the target areas, however, some of the farmers and CFRs which benefitted from the Project also benefit later from other interventions.

4-1-2. Effectiveness

(1) Prospect of achieving the Project Purpose

As described in the "3-2-2. Achievement of Project Purpose", it was estimated that the indicator of the Project Purpose is likely to be achieved. Therefore, there is a good chance of achieving the Project Purpose. While other conditions to achieve the indicator have been met, the continuity of grow-out farmers is the main concern for the achievement of Project Purpose. The continuity has been affected negatively by the climatic situations every year during the project period. Since the achievement of the Project Purpose largely depends on the weather conditions, it may be necessary to consider additional measures to mitigate the negative effects of extreme weather.

(2) Causal relationship between the Outputs and the Project Purpose

The causality between Outputs and Project Purpose is considered adequate, since each Output is necessary factor to increase the amount of fish production of the small-scale fish farmers.

There are 3 external factors described in the PDM, which may have certain effect on the achievement of the Project Purpose. Firstly, natural disasters, such as droughts, floods, etc. have been considered as a main negative factor for extending small-scale aquaculture production, and they actually had considerable effect on the seed production and grow-out every year during the project period. As described in the Table 4-1, the flooding caused the loss of broodstocks and fingerlings for FSPs and farmed fish for grow-out farmers. The Project responded to the damages with providing some additional support, including the provision of broodstocks to the FSPs (in 2011 and 2013), the provision fingerlings to grow-out farmers (in 2011). From 2013, the Project decided to provide the protection net to new fish farmers to mitigate the damages, and it actually reduced the damages for some farmers, while other farmers suffered from serious damages as water level got higher than the net. The experiences of flooding also discouraged farmers to start or continue grow-out in fear of the damage repeat. The lack of rainfall also limited the amount of fingerlings FSPs can produce, and impeded farmers from starting or continuing grow-out since they did not have enough water in their ponds.

Table 4-1: Effects of extreme weather events during the project period

Period	Situation of damages/problems
October 2011	Flooding caused the following damages; • 2 FSPs in Siem Reap, 2 in Pursat and 1 in Battambang lost a total of 300kg broodstocks in total. • 70% of grow-out farmers in Siem Reap and 30-50% of them in Battambang and Pursat lost a certain number of fish, and 53 farmers in Battambang, 50 in Siem Reap, and 8 in Pursat lost all of their farmed fish.
2012	Despite general expectation for abundant rainfalls and river water, low precipitation throughout the rainy season caused declining of the amount of seed production for a part of FSPs.
May to July 2013	Lack of rainfall caused the following problems; • The amount of seed production was limited for many FSPs in Pursat and Battambang. • There was not enough water to start fish farming for many grow-out farmers in Pursat and Battambang.
September - October 2013	Flooding caused the following damages; • In Battambang, 11 FSPs lost 1,053kg broodstocks in total and 718,000 fingerlings (38% of total amount of production). All of 16 communes targeted for FTF training in 2013 were flooded, 177 target households (46%) lost almost all farmed fish. • In Siem Reap, 5 FSPs lost 3,944kg broodstocks in total and 19,500 fingerlings (2% of total amount of production). In 6 communes, 77 target households of FTF training in 2013 (23%) suffered from the flood. • In Pursat, I FSP lost 30,000 fingerlings (5% of total amount of production).

	• At the CFR site in Battambang, a part of bank and pipe of the Pond were broken, and many broodstocks were washed away.
May – September 2014 (ongoing)	Lack of rainfall has been causing the following problems; • The amount of seed production is limited for many FSPs in Pursat and Battambang. • There is not enough water to start fish farming for many grow-out farmers in Pursat and Battambang.

Secondly, as to the outbreaks of serious fish diseases in the target area, there was no such incident during the project period.

Thirdly, regarding the changes of supply balance of fingerlings caused by imported fingerlings from neighboring countries, the imported seeds which have been distributed so far in some part of target provinces are only non-target species, such as Walking catfish and Pangasius, mainly from Vietnam. Since those species especially Walking catfish are high in demand and many FSPs are planning to produce them near future, they may compete with the production of target FSPs. Also, the realization of ASEAN Economic Community would accelerate the distribution of imported commodities including fingerlings.

4-1-3. Efficiency

(1) Level of achievement of the Outputs

As described in the "3-2-1. Achievement of Outputs", as to the Output 1, the technical improvement on the small-scale seed production and grow-out was progressed, and it is considered that necessary techniques for target species in both seed production and grow-out were developed sufficiently. Regarding the Output 2, the capacity of C/P staff members for local aquaculture extension services in general is considered strengthened, while there are some items, such as the seed production of Silver carp and Mrigal which have not reached to the adequate level in the capacity assessment yet. As to the strengthening of FSP's capacity (Output 3), many farmers have enhanced their technical capacities to produce fingerlings, although there is variability among FSPs in the survival rate at nursing stage due to the various conditions required. As a result, the amount of seed produced by FSPs was doubled, however, the sales income did not increase as much as expected due to the damages caused by flooding and negative effects resulted from the lack of rainfall. With regard to the extension of small-scale aquaculture in the target provinces (Output 4), the numerical target of the number of trained farmers was achieved successfully, and all 4 target CFRs sites are managed properly in general in accordance with their regulation. As for the Output 5, the network of FSPs in each province is functioning independently, under the mutual collaboration of farmers depending on their needs.

Above all, all Outputs were achieved and the level of achievement is considered satisfactory in most of the indicators, except that the external factor affected the level of achievement of an

indicator for Output 3. The level of achievement can be enhanced in the rest of project period especially in Output 2 by strengthening the weak point identified by the assessment, and in Output 3 by considering the further measures to improve the nursing stage and to mitigate the damage of extreme weather.

(2) Causal relationship between the Outputs and Activities

The above mentioned Outputs were produced as a result of the project activities. The CFR is considered to be contributed to increase fish consumption for residents surrounding the CFRs who are mostly in poverty and dependent on natural fish resources.

Regarding the Important Assumptions to achieve the Outputs "The local extension staff, FSPs, and small-scale fish farmers trained by the Project continue working for their respective positions in the target provinces", 5 C/P staff members were replaced, including 2 cases of replacement due to the death of personnel in charge of Toek Vil Station. The unanticipated replacement of 2 personnel of Toek Vil Station affected the implementation of activities, since these 2 were experienced staff members. Also 4 FSPs stopped their seed production due to their personal and family issues, which directly affects the level of achievement of Output 3, the amount of seed supply, and the extension of small-scale aquaculture through the FTF training. The Project Team made an effort to develop additional FSPs in the 4th year. As to the small-scale fish farmers, although the actual number of those who suspended grow-out practices is unknown, a certain number of farmers were considered to be discouraged by the negative effects of extreme weather. As another factor of their suspension, there are farmers who migrate or temporarily move to Thailand in pursuit of an opportunity for cash income.

(3) Factors which affect the achievement of Output

Some factors which promoted or impeded the progress of activities and the achievement of the Outputs were identified as followings;

[Promotional factors]

- After recognized the different conditions of the target provinces comparing with the sites of FAIEX-1, FiA responded flexibly by providing additional C/P staff necessary for the implementation of the project activities.
- The experiences and human resources of FAIEX-1 were available for the Project to implement activities smoothly and enhance the achievement. For example, the staff members of FiA and advanced farmers from Takeo, Kampong Speu and Prey Veng Provinces who have enough experiences from FAIEX-1 provided support when it was necessary to prepare urgently the Cambodia model hatchery facilities, and there were some opportunities which FSPs of FAIEX-I support or participated in the training of FAIEX-2 to instruct some techniques and

share experiences of seed production.

- The network of FSPs has been functioning quite well especially among active FSPs in individual level. The information exchange on the technical issues, availability of broodstocks, customers and species in demand has been done frequently, which contributed to enhance technical capacities, and increase the amount of production and sales.

[Obstructive factors/ issues]

- The Project established criteria for the selection of FSPs and grow-out farmers, such as availability of water, ponds, investment (only FSPs), labor, willingness, and son on, considering the success and sustainability of their activities. However, there was limited number of farmers who meet requirement established by the Project to become FSPs or grow-out farmers comparing to the experiences of FAIEX-1, and therefore the selection was difficult for the Project Team. Also there were delays in the preparative activities for some FSPs due to the lack of fund, time and water.
- In many areas of the target provinces water is scarce for aquaculture. Especially for FSPs, quality and quantity of water were important conditions for seed production, and insufficiency of water limited the amount of fingerlings they can produce. For grow-out farmers, those who have water throughout year can continue their fish farming with their stocks and naturally reproduced fish larvae, and only purchasing additional fingerlings when they can afford. However, those who have no water in the pond during dry season, they harvest all fish before water dry up, and need to purchase fingerlings every year.
- As it pointed out by the Midterm Review also, the target provinces of FAIEX-2 are areas where the aquaculture is not as familiar as those of FAIEX-1 and therefore it was difficult to accept the grow-out practices without experiences. It was observed by some FSPs that farers sometimes do not follow the instruction given by FSPs and fail in their production.
- The target area of project activities was extended to remote areas in the target provinces, in order to identify potential FSPs and grow-out farmers. It was difficult for the Project Team, especially for the C/P extension officers, to travel long distance to visit them frequently for on-firm instructions and monitoring, especially during rainy season, when the condition of road did not permit.
- Since the project period was shorter than that of the FAIEX-1, it was difficult for some FSPs to obtain enough experiences and technologies during the Project Period, especially those who got involved in the Project from 2013 and 2014.

(4) Timing, quality and quantity of the Inputs

Generally the inputs provided during the project period were utilized directly in the project

activities. Some additional financial input was provided by Japanese side to strengthen FSPs' production capacity, and for both FSPs and grow-out farmers to recover from flood damage. Also, additional 4 C/P staff members were allocated by Cambodian side to cover large number of farmers and extended areas of the project activities in the target provinces.

4-1-4. Impact

(1) Prospect of achieving the Overall Goal and Causal Relationship between the Project Purpose and the Overall Goal

As it described in "3-2-3. Prospects to achieve Overall Goal", although FSPs have been already extending their sales to new farmers by themselves with providing technical instructions for grow-out, the number of new farmers varies considerably so far depending on each FSP, and it is quite difficult to estimate the achievable number, because the market tendency and demand of fingerlings from small-scale farmers could not be understood based on the data and experiences of past 3 years, due to the effects of extreme weather.

As to the Important Assumption to achieve the Overall Goal "Prices of cultured fishes are not largely declined", the price of fingerlings shows a slightly upward tendency, and there is no decline so far in the target provinces.

(2) Multiplied effects of the Project

Some multiplied effects of the Project were identified including followings;

- Many farmers revealed that the volume of household fish consumption was increased in both FSPs and small-scale fish farmers, because of the improved access and availability of fish.
- At all 4 CFRs sites, the villagers commented that they can catch more fish than before the Project in the surrounding ponds, canal, and paddy fields connected to the community pond.
- With some instructions on the environmental effects of the Project, some FSPs applied seed production techniques leaned from the Project to produce non-target species, such as Clarias, Pangasius and Anabas, based on the market demand. Especially many farmers are more interested in producing Clarias than at the moment of Midterm Review, since the demand from grow-out farmers is getting higher because of the shorter feeding period. Some FSPs have been exchanging the technical information, broodstocks, and market information of these non-target species also.
- The Project received many visitors and study tours from different groups, including the JICA's technical cooperation projects in other countries such as Laos, Madagascar, and Benin, and other donor agencies such as USAID and Worldfish Center. The Project is considered as a model of aquaculture extension even for other developing countries, and contributed to demonstrate its FAIEX approach to them.

4-1-5. Sustainability

(1) Policy and institutional aspects

In accordance with the policy and strategy of Cambodian Government described in the "4-1-1. Relevance", FiA will continue to promote aquaculture development in the country. Therefore, the political support of the Government is considered to be maintained to enhance the effects of the Project and achieve the Overall Goal in the future.

(2) Sustainability of FSPs

As FSPs play key roles in the extension strategy of the Project, the Project offered as much supports as possible for them during the project period. As a result, FSPs are considered to have gained enough capacity to produce fingerlings to get enough profit to sustain themselves, and keep providing fingerlings and technical instructions to small-scale grow-out farmers. However, the degree of production capacity varies among the 40 active FSPs.

Regarding the technical aspects, it is considered that all FSPs, except newly involved 3 farmers, have technical capacities to produce at least 3 species, as described in the achievement of Output 3. However, some farmers selected in 2013 and 2014 still need more experience and technical guidance in the seed production. As actual technical need of many FSPs, they request training on the seed production of other non-target species, especially Walking catfish, because of the high demand.

As to the other production capacity, after the basic facilities and ponds were prepared with some support of the Project, those FSPs who have already produced a large amount of fingerlings have been strengthening their facilities and ponds by themselves to increase their production capacity. However, some farmers claim that a lack of facility and ponds limits their production capacity. A lack of water is also one of the major limiting factors, and almost half of FSPs do not have available water in dry season. For them, a shortage of rainfall in early rainy season can affect negatively the fingerling production of 4 target species (except Tilapia) which have a restricted breeding season.

As to the marketing of fingerlings, some FSPs claim that there are not enough farmers to buy their products, especially when water is scarce to fill their ponds to start grow-out. But there are some others who think the number of new customers is increasing due to the decrease of wild fish. There are a few FSPs who have extended their sales to medium and large scale grow-out farmers, private companies, and donors/NGOs which support aquaculture program in different provinces. In order to meet the preference of species and demand of customers who buy in bulk, FSPs are communicating each other individually among the network and exchanging market information. In addition, some FSPs have sales strategies, such as giving some additional fingerlings away for customers, discounting the price of fingerlings for their neighboring farmers, producing only certain species in high demand, and so on.

(3) Organizational and financial aspects of C/P agency

It is considered that the C/P extension officers in the target provinces will remain in the same position and continue to support FSPs. However, the budgetary constraints will restrict their visit to FSPs and their extension activities to other districts and communes.

FiA central will continue working on the extension of aquaculture in the country, and has been planning the activities for 2015 by the end of this year. Based on the political priority, it will have larger budget than past years for aquaculture development, which is approximately 123,000 US dollars, and also will have 648,000 US dollars support from EU for aquaculture development. According to the Director General, it will implement similar project to FAIEX, using the experiences of the Project.

(4) Utilization of machinery, equipment and facilities

The machinery and equipment provided by the Project will be utilized by DAD for the activities of aquaculture extension. There is a concern over the cost for maintenance of these inputs provided on a limited budget.

(5) Environmental aspects

As more FSPs are interested in producing hybrid Walking catfish, many of them already have African origin broodstocks in their ponds. Although the Project provided information about adequate management of such species to FSPs, a stricter measure might be necessary to prepare against heavy flood.

4-2. Conclusion

The relevance of the Project was confirmed as high, in terms of the consistency with needs of Cambodian rural communities and target areas, policy of the Cambodian Government, and Japanese ODA policy. The approach of the Project, which is characterized by FTF training of the FAIEX model, is also considered relevant as means to contribute to the aquaculture extension in Cambodia.

As to the effectiveness, there is a high prospect of achieving the Project Purpose, since the indicator is likely to be achieved. The continuity of grow-out farmers is the main concern to achieve the indicator of the Project Purpose, and it is mainly attributed to an external factor which is the negative effect of extreme weather occurred every year during the project period. Since the achievement of the Project Purpose largely depends on the weather conditions, it may be necessary to consider additional measures to mitigate the negative effect of extreme weather.

With regard to the efficiency, the inputs provided by the Project were utilized directly for the project activities, and the Outputs were mostly produced as a result. Some issues remain in the

capacity development of C/P staff and FSPs, which may be necessary to deal with in order to enhance the level of achievement. Also, the sales income did not increase as much as expected due to the damages caused by flooding and negative effects resulted from the lack of rainfall.

As for the impact, the effects of extreme weather made it difficult to understand the magnitude of FTF extension in next 3-4 years to foresee the achievement of the Overall Goal, while FSPs have been already extending their sales to new farmers by themselves with providing technical instructions for grow-out, although the number of new farmers varies considerably so far depending on each FSP. In addition, some multiplied effects of the Project were identified, including the increase of household fish consumption for farmers, the increase of fish catches in surrounding areas of CFR sites, and so on.

The sustainability in political and institutional aspects is considered to be maintained, since the Project is consistent to the Governmental policies and strategies. As to the sustainability of FSPs, while the production and sales capacity still varies among FSPs, some FSPs have making efforts to improve it, by investing in their facilities and ponds, and having their sales strategies to extend customers. As for FiA, in spite of the budgetary constraints, it will maintain the support to FSPs in a less intensive manner, and similar project will be implemented to extend aquaculture in the country.

In conclusion, the Project Purpose is likely to be achieved by the end of the project period.

Chapter 5: Recommendations and Lessons Learned

5-1. Recommendations

(I) Technical improvement of seed production

There are following technical suggestions for the improvement of seed productions to be taken into granted.

- As all hatcheries are operating in small scale and the nursing space is limited for their production, FiA/Project should encourage producers to specialize on the seed production of one or two species only to improve the survival rate and the overall quality of seed;
- To increase the number of breeding and enhance the total fish production per year, FiA/Project should promote and encourage the farmers who want to start a nursing farm to build ponds separately from hatchery and other nursing farms;
- Through the extension services, the hatcheries development should be promoted in the areas where water is sufficient or nearby water sources;
- It is necessary to develop broodstocks with good genetic quality and provide to seed producers, by partially replacing broodstock annually from adequate sources;
- FSPs should create large reservoir pond, at least 4 meters depth to keep water during the dry season, which can be a countermeasure against draught.

(2) Countermeasures against flood damages for FSPs

The Project experienced damages of extreme weather, especially by floods, every year during the project period. One of the serious effects on the seed production is the loss of broodstocks which affect the production in next few years since it takes time to develop the broodfish. In order to mitigate such problems, it is recommended that the Project and FiA continue facilitating FSPs to prevent broodstock escape by establishing such facilities as floating cage, elevated dikes and land-based cement tanks. In so doing, the intrusion of African origin Walking catfish into natural water bodies also can be avoided.

(3) Strengthening of FSPs especially those who started in 2013 and 2014

FSPs have been strengthened through the various supports of the Project, and achieved the indicators of Output 3 mostly. However, analyzing individually, some FSPs, especially those who started in 2013 and 2014 have not increased and stabilized their seed production yet. It is recommended that the Project Team give priority to those new FSPs during the rest of project period, including the technical instructions on the nursing stage of the seed production. Also, it is expected that FiA will continue to support them even after the completion of the Project, with allocating inputs necessary to secure the support activities.

(4) Measures to enhance the sales of fingerlings

While some farmers think that the demand of fingerlings is increasing, others have difficulties in getting enough number of customers to sell their products. Also there are some farmers who have set up their sales strategies to enhance their sales. Since the marketing of fingerlings is an important factor to sustain and develop seed production, it is recommended to the Project Team to explore measures for FSPs to enhance sales of fingerlings and share with FSPs before the completion of the Project. It may be effective to promote the collaborative relationship among the network of famers, and with communes, donors, NGOs, and private firms to extend their sales opportunities.

(5) Utilization of the Project's experiences and good practices for the extension activities in other provinces

During the project period the Project accumulated experiences of aquaculture extension services and good practices which should be utilized in the future when FiA implements similar projects in the other provinces. Therefore, it is recommended to the Project to make an effort to disseminate such experiences and good practices to FiA Cantonment offices in other provinces and relevant parties in order to provide practical information for future activities.

(6) Maintenance of rice-cum-fish culture and CFR demonstration sites

In addition to earthen pond culture, the Project carried out demonstration of rice-cum-fish culture in strategic sites, and established model CFR in selected communal pond areas. Both activities aimed at increasing opportunities for rural people to access food fish. Although these activities generate substantial benefits to the people directly involved in the activities in the short run, the rice-cum-fish culture demo plots is also expected to generate demonstration effects, and CFR modeling is expected to produce replications in other communities. For this, it is recommended to maintain these rice-cum-fish demo plots and CFR model communities so that more people may be interested in these activities.

(7) Toek Vile Fish Seed Production Station

The Project has contributed not only to upgrading of some key facilities and equipment in the Toek Vile Station but also to skills enhancement for the staff members of the Station. With this, the Station is now functional in terms of technical backstop to respond to farmers' needs and technical problems, and broodstock center to supply quality fish to FSPs and private hatcheries. It is therefore recommended to maintain these important functions as much as possible, with a proper allocation of financial resources even after the project period.

5-2. Lessons Learned

(1) Farmer-to-farmer Extension

Successful implementation of both FAIEX-1 and FAIEX-2 projects in different target areas of Cambodia has demonstrated that farmer-to-farmer extension approach is one of the most effective tools for rural livelihood improvement. Its main mechanisms include economic incentive and social incentive that motivate so-called core-farmers to function as farmer extension agent. They perform as FSPs and at the same time as teachers to teach grow-out farmers fish farming techniques. Grow-out farmers who initially lack knowledge and skills in aquaculture buy seed and in return get technical advices. As long as this reciprocal relationship between FSPs and grow-out farmers is maintained, both sides can enjoy the benefits out of this win-win business model. It is noteworthy that in order to establish the FTF extension the identification and selection of right core-farmers are crucial. The qualifications and/or characteristics to be met by the potential FSPs include the strong commitment on hard-working, respected by the community, and altruistic, among others.

(2) Networking of core-farmers

According to the experiences gained by FAIEX-1 and FAIEX-2, networking of core-farmers is proven to be an efficient and effective method to sustain the whole extension system. The networking was initially assisted by the project intensively and afterward it is managed and operated by farmers themselves. It implies that the network members recognize the usefulness of the

networking to enjoy mutual benefits derived from interactions and communications on seed production technology, seed supply/marketing and broodfish lending/borrowing. It also functions as a platform to connect farmers and government.

(3) Identifying how to share the responsibility in aquaculture extension between FiA at central level and field extension officers in FiA Cantonment

During the project period, knowledge and technology about freshwater aquaculture development have been transferred effectively to field extension officers by staff members of FiA central. FAIEX has been successful in sharing responsibility between FiA central and field extension officers in FiA Cantonment. Through experiences in assisting FSPs and grow-out farmers, field extension officers accumulated extension skills and improved their capacity on aquaculture extension services. By establishing a workable framework of extension service, the capacity of field officers in Cantonment has been strengthened to the satisfactory level.

(4) Generating a strong demand for seeds for the stable business of seed production

In early stage of the development of seed production, FSPs may suffer from lack of demand for seed even if they adopt FTF methods in proper way. In such situation, the seed production business remains unstable. The Project dealt with such situation by organizing FTF training for fish farmers who are potential buyers of fingerlings from FSPs. FiA central and FiA Cantonment offices have cooperated continuously together with commune councils, NGOs, and donor agencies, in order to identify potential buyers, and then FSPs can gradually expend their own marketing network. Then FSPs eventually evolve into mature in economic terms, being able to run business independently.

(5) Grow-out farmers

It was confirmed that small scale fish farming makes significant contribution to the nutrition, food security and sustainable livelihoods in the target areas of the Project. In order to encourage the farmers to continue fish culture successfully, it is essential to give close monitoring to their activity from the preparation of ponds until the harvest. In addition, the integrated farming of fish culture with homestead garden is a very efficient method that could interact each other.

(6) Fish seed producers

FSPs may at first require incentives to try new practices or technologies to help them overcome barriers such as capital cost or perception of risk, which was successfully dealt with by the FAIEX1-2. In order to develop their seed production successfully, regular supervision/monitoring by both FiA central and cantonment was a key important factor.

(7) Effects of extreme weather

In the Project, natural disasters, such as droughts, floods, etc. was considered as an external factor for the achievement of the Project Purpose. As mentioned repeatedly, it actually had considerable effect on the seed production and grow-out every year during the project period, and thus affected negatively the small-scale aquaculture production. Since such effects of extreme weather or climate change occur more frequent than ever, it may be necessary to consider it as internal factor, and include adequate measures to mitigate the negative influences or avoid risks in the framework of the project design.