

Chapter 5

Action Plan

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5.1 Components of the Action Plan

In this chapter, practical projects, in other words ‘Action Plan’ (A/P) as a whole will be proposed in order to realize development directions suggested in Chapter 4 ‘Master Plan for Promotion of Inland Aquaculture’. The A/P is composed of the fifteen projects, enlisted as follows.

The structure of Action Plan is compiled and shown below, upon the orientation by issue and by region indicated in the Master Plan.

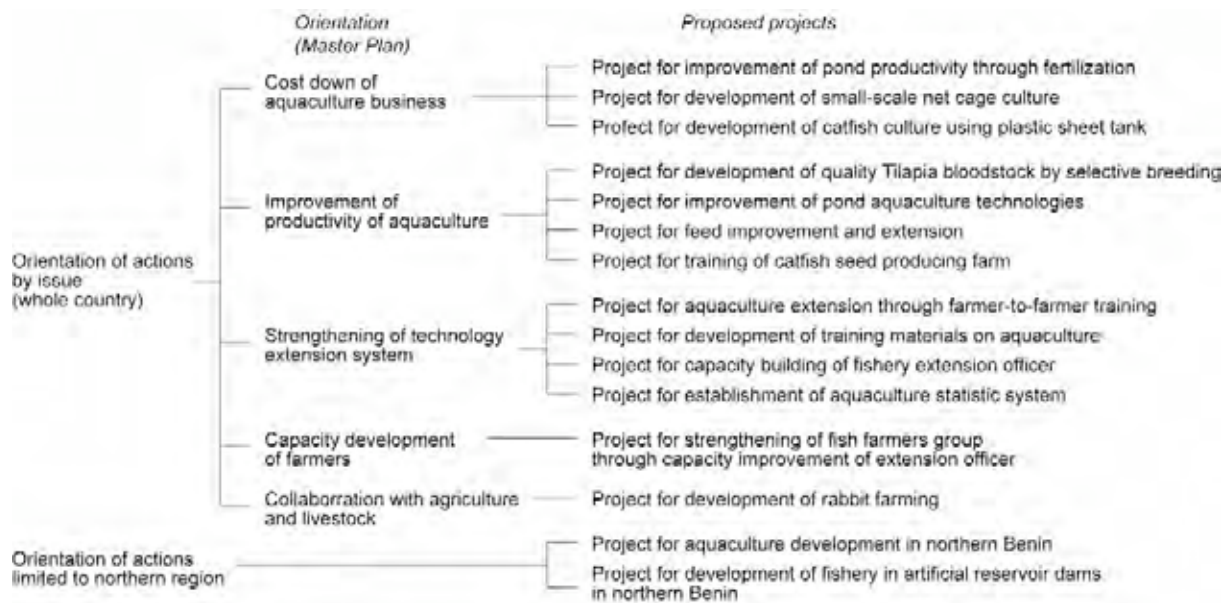


Fig. 5-1. Structure of Action Plan

5.2 Basic Approaches

Projects which are targeted for small- and middle-scale farmers shall pursue sustainability through application of low cost and simple techniques suitable for the rural environment. Therefore, this A/P does not include construction of facilities for large-scale aquaculture which could be operated by top down management with big investment.

In order to make the activities sustainable, every project is to be implemented with taking such view points into account as follows.

- Projects ask either individual recipients or groups for their own contribution in proper way, such as payment of cash, provision of labor, and/or materials, when the feasibility of activities has been verified technically and financially.
- In case that group activities are targeted, project will never select such groups as organized just to accept materials and technological supports.
- If the feasibility is verified technically and financially, project will provide training to targeted farmers, both individuals and groups. Only those who complete the training will be able to receive materials or technological services. Provision of materials would be limited in number. However, technical supports will be continuously provided by trainers of responsible organizations or through public extension offices, such as CeRPA or CeCPA, in terms of a technical follow-up.
- Seeds and feeds for aquaculture will be sold and supplied through private sector, such as core farmers or traders. Therefore, projects also support private sectors for encouraging these activities.

The A/P Covers activities in whole country aiming at improvement of aquaculture nationwide although the development potential of regional aquaculture is taking into account. Target areas of each

project are specified in Table 5-1.

Table 5-1 Spatial distribution of suggested projects

	Projects	Target Area
1)	Project for improvement of pond productivity through fertilization	6 districts in the southern region
2)	Project for development of small-scale net cage culture	5 cities around the Nokoue Lake
3)	Project for development of catfish culture using small-scale plastic sheet tanks	Ouémé and Plateau districts
4)	Project for development of quality Tilapia broodstock by selective breeding	Whole county
5)	Project for improvement of pond aquaculture technologies	Whole county
6)	Project for feed improvement and extension	Whole county
7)	Project for training of catfish seed producing farmers	Whole county
8)	Project for aquaculture extension through farmer-to-farmer training	6 districts in the southern region
9)	Project for development of training materials on aquaculture	Whole county
10)	Project for capacity building of fishery extension officer	Whole county
11)	Project for establishment of aquaculture statistics system	Whole county
12)	Project for aquaculture development in northern Benin	5 districts in the northern region
13)	Project for development of fishery in artificial reservoir dams in northern Benin	5 districts in the northern region
14)	Project for strengthening of fish farmers' group through capacity improvement of extension officer	Whole county
15)	Project for development of rabbit farming	Whole county

Notes) 6 districts in the southern region include Mono, Couffo, Atlantique, Ouémé, Plateau, and Zou.

5 districts s in Northern region includes Collines, Atacore, Donga, Borgou, and Alibori.

5 cities around the Nokoue Lake includes Abomey-Calavi, So-Ava, Porto-Nobo, Aguegue, and Seme-Kpodji.

5.3 Scope of the Action Plan

5.3.1 Project for improvement of pond productivity through fertilization

(1) Background of the project

In southern Benin, there are many aquaculture farms using various water sources such as spring, barrage as well as rivers, and therefore the development potential is considered modest or high. These ponds, however, face a common problem, namely low productivity. In many cases fish ponds are located far from residential area. They are not fertilized artificially, or are not received natural inflow of livestock manure such as poultry or cow. Generally these ponds are in light brown to transparent in color, meaning that there are few blooming of phytoplankton. Under these conditions, the pilot project has verified that the productivity could be improved and the costs for aquaculture could be reduced in fish ponds, if water conditions are improved through fertilization of proper materials in adequate way. In particular, fertilization collaborated with pig farming was proved to enable harvesting fish without feeds. Based on the result of pilot project, this project pursues extension of aquaculture in combination with pig farming and decrease of cost for aquaculture.

(2) Objectives and Indicators

Short term objective:

Cost of Tilapia culture is decreased through fertilization in collaboration with pig farming.

Middle and long term objective:

Tilapia culture in fertilized ponds without feeding in collaboration with pig farming is extended.

Indicators:

Number of farmers who implement aquaculture using organic fertilizer obtained from pig farming

Number of farmers who succeed reduction of production cost of aquaculture through fertilization in collaboration with pig farming.

(3) Outcomes to be expected

- Farmers who have engaged in pig farming start Tilapia culture.
- Farmers who have engaged in aquaculture start pig farming.
- Aquaculture can be practiced at low cost.

(4) Activities

1) Target area: 6 districts in the south (43 cities)

2) Target group:

'173 fish farmers who have also been engaged in pig farming' and '100 pig farmers who would like to start aquaculture'

3) Major activities

- ① List up the name of farmers who have already been engaged in pig farming, and fish farmers who are raising pig.
- ② Encourage fish farmers to excavate manure pits by aquaculture extension officer
- ③ Supply and provide seeds to fish farmers who have been equipped with manure pits
- ④ Encourage farmers who conduct pig farming to participate in farmer-to-farmer training on aquaculture
- ⑤ Provide loan using supporting fund for excavating fish ponds to farmers who have already been engaged in pig farming
- ⑥ Supply and provide fish seeds to pig rearing farmers who have dug ponds
- ⑦ Aquaculture extension officer of CeCPA provide technical follow-up

4) Project period: 3 years

(5) Inputs

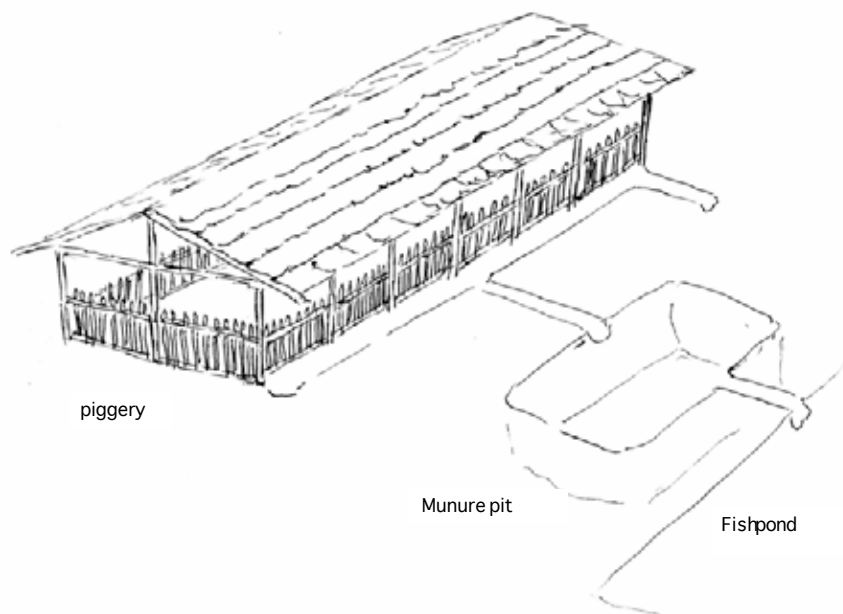
Inputs to the project are estimated as follows.

Table 5-2 Estimated cost of the project for improvement of pond productivity through fertilization

Activities	Items	Unit price	Quantity	Amount	Remarks
Support for excavation of pond	Support fund for excavation of ponds	2,000	20,000 m ₂	40,000,000	Fund will provide necessary finance support for 100 farmers who do not have pond yet. Each farmer receives capital to excavate 200 m ₂ pond from the fund. Recipient must return 50 % of the cost. Unit price of excavation is calculated as 2000 FCFA per m ₂
Support for fish seeds procurement	Tilapia seeds supply to existing aquaculture farmers (including transportation fee)	20	415,200 seeds	8,304,000	2400 seeds will be provided for 173 farmers respectively. (necessary number of seeds is calculated by stocking density of fish at 3 fishes /m ₂ in 800 m ₂ of pond) (Unit price of seeds is estimated as 20 FCFA because recipients will bear 50 % of the costs.)
	Tilapia seeds to existing pig farmers (including transportation fee)	20	60,000 seeds	1,200,000	600 seeds will be provided for 100 farmers respectively. (necessary number of seeds is calculated by stocking density of fish at 3 fishes /m ₂ in 200 m ₂ of pond) (Unit price of seeds is estimated as 20 FCFA because recipients will bear 50 % of the costs.)
Total				49,504,000	

(6) Remarks based on the result of pilot project

- Examine the site specific conditions, since the effect of fertilization would be different due to the effect of water quality and quantity.
- Dried cow dongs which have been collected at outdoor are less effective and costly. Therefore, fresh and raw livestock manure is recommendable as fertilizer.
- Sometimes it might be difficult to procure livestock manure as fertilizer, and efficiency of fertilizer might depend upon the fish species or condition of water. Therefore, it must be taken into account that fertilization is not always the best solution. Flexible approaches such as partial feeding are also suggested to be applied depending on the situation.



5.3.2 Project for development of small-scale net cage culture

(1) Background of the project

In southern Benin, there are several brackishwater lakes/lagoons such as Nokoue Lake (150km²), Aheme Lake (78km²) and Porto-Novo Lagoon (35km²). They are utilized for Acaja or various types of fishery. However, the productivity has almost reached to the maximum level and will not be able to be improved any more. Considering these situations, there have been discussions regarding the possibility of aquaculture development in brackishwater lakes, and necessity of development of target species which can be adoptable to brackishwater condition and extendable.

In a pilot project of this study experimental culture of three potential fish species such as a brackishwater catfish, *Chrysichthys nigrodigitatus*, brackishwater tilapia, *Sarotherodon melanoteron*, Tilapia, *Oreochromis niloticus* was carried out, and Tilapia was confirmed to show the best growth. It was proved that Tilapia was able to be cultured under water condition containing the salinity of 10 to 15ppt. The pilot project even showed that Tilapia grew better than in freshwater.

Tilapia aquaculture in large-scale net cages has been conducted by a farmer's group in Grand-Popo. The results indicated that it would be highly possible to make profit from Tilapia aquaculture in such brackishwater net cages, when the culture conditions such as water environment at the site, quality of feeds and feeding techniques were preferable. In this project, net cages are to be introduced to the 5 cities where brackishwater lakes are located.

(2) Objectives and Indicators

Short term objective: Number of farmers who carry out net cage culture is increased.

Middle and long term objective: Productivity of aquaculture through net cage culture is increased

Indicators: Number of farmers who carry out net cage culture

(3) Outcomes to be expected

- Small-scale net cages are extended in brackishwater lakes/lagoons
- Farmers around brackishwater lakes/lagoons achieved fish production by net cage culture

(4) Activities

- 1) Target area: 5 cities (Abomey-Calavi, So-Ava, Porto-Nobo, Aguegue and Seme-Kpodji)
- 2) Target group: 100 fishers or farmers who live around the coastal zone and own pirogue(s).
- 3) Major activities
 - ① List up names of farmers who want to start net cage culture
 - ② Provide net cage by loan (half of the cost will be paid by beneficiary)
 - ③ Provide seeds for one cycle of cultivation
 - ④ Provide combined feeds for two cycles of cultivation
 - ⑤ Provide technical instruction and management advice
- 4) Project period: 4 years

(5) Inputs

Inputs to the project are estimated as follows.

Table 5-3. Cost estimation of the project for development of small-scale net cage culture

Activities	Items	Unit Price	Quantity	Amount	Remarks	
Equipment and Material Support	Net cage (20 m ₂)	100,000	100	farmers	10,000,000	one set will be provided for each farmer Recipients will bear 50 % of the costs
	Material for aquaculture (scoop net, bucket, set of measures)	25,000	100	farmers	2,500,000	”
Seeds and Feeds for aquaculture	Seeds (for the 1st trial)	40	100,000	seeds	4,000,000	1000 seeds will be provided for 100 farmers for free of charge at the 1st trial only.
	Feed (for the 1st trial)	250	30,000	kg	7,500,000	Feed for the 1st trial will be provided for 100 farmers. Necessary feed amount for one cycle of production will be estimated 300 kg as following assumption (survival rate will be 80 %, fish will grow approx.150 g by FCR 2.5)
	Feed (for the 2nd trial)	250	30,000	kg	7,500,000	”
Total					31,500,000	

(6) Remarks based on the result of pilot project

- Small-scale and simple net cage will be introduced. Upon the determination of the facilities to be introduced, not only floating net cage but also pole-fixed type net cage like hapa net will be examined due to the site situation considering the price, endurance and flexibility of management.
- Net cages shall be deployed at the place where easy to watch frequently in order to avoid theft.
- Net cages shall be checked periodically with special attention to the potential damages.
- Instruct farmers to observe fish feeding very carefully in order to avoid excess feeding.

5.3.3 Project for development of catfish culture using small-scale plastic sheet tanks

(1) Background of the project

Even among villagers who do not have fish ponds or suitable land for aquaculture at present, there are many who want to start aquaculture for income generation or means of diversification of livelihood. In order to support these villagers to start aquaculture easily, such a new method of catfish cultivation have been introduced for these years. The method is to rear fish in small wooden water tank (2.8-4.0m length, 0.8-1.0m width) coated inside with plastic sheet. Currently, there are observed several farmers who have introduced this method in the southern districts, namely Ouémé and Plateau. There are also progressive fish farmers who utilize iron tubs (1_2m) or self-assembled small tanks (2_2m-2.5_3.3m) made of concrete blocks for seed production of catfish in backyard. Those types of small-scale aquaculture method would involve several merits comparing to ordinary pond culture, for example it is easy to harvest, the production cycle is shorter, few possibility to be stolen since tanks can be placed close to the residents, and enable the producers to supervise feeding frequently. In this project, beneficiaries will be supported with a part of materials for fabricating tanks, as well as seeds and feeds for catfish cultivation. Then it finally aims to increase an expansion of small-scale catfish culture.

(2) Objectives and Indicators

Short term objective: Number of catfish producers is increased

Middle and long term objectives: Aquaculture production of catfish is increased in the target area

Indicator: Number of catfish producers who operate small-scale plastic sheet tanks

(3) Outcomes to be expected

- Number of catfish producers using small-scale plastic sheet tanks is increased.
- Catfish aquaculture becomes possible for people who are not farmers and/or do not own ponds or lands.
- It becomes easy for women to start aquaculture.

(4) Activities

1) Target area: Ouémé and Plateau districts

2) Target group: A total of 1000 entities, targeting 2% and 1% of agriculture households in Ouémé and Plateau, respectively.

3) Major activities

- ① List up the people who want to participate in catfish culture using plastic sheet tank (women's participation will be encouraged)
- ② Provide wooden tanks coated inside with plastic sheet by loan (half of the cost will be paid by beneficiary)
- ③ Provide training on fabricating tanks and rearing techniques of Clarias at CeCPA level.
- ④ Provide Clarias seeds and compound feeds for two cycles of rearing
- ⑤ Provide technical training and management advice.

4) Project period: Three years

(5) Inputs

Inputs to the project are estimated as follows.

Table 5-4. Cost estimation of the project for development of catfish culture using small-scale plastic sheet tanks

Activities	Items	Unit Price	Quantity	Amount	Remarks
Tank fabrication (beneficiary will bear the costs partly)	Materials to fabricate the plastic sheet tank (Plastic sheets, set of timbers)	25,000	1,000 household	25,000,000	one set will be provided to respective 1000 farmers (Beneficiary will bear half of the costs)
		(50 % of the full price 50,000)			
Fish seed and feed	Seeds (for 1st trial)	100	100,000 juveniles	10,000,000	100 fish seeds will be provided to respective 100 farmers (free of charge)
	Seeds (for 2nd trial)	50 (50%)	100,000 juveniles	5,000,000	100 fish seeds will be provided to respective 100 farmers (Beneficiary will bear 50 % of the costs)
	Feeds (for 1st trial)	250	80,000 kg	20,000,000	80 kg of feed will be provided to respective 100 farmers (free of charge)
	Feeds (for 2nd trial)	125 (50%)	80,000 kg	10,000,000	80 kg of feed will be provided to respective 100 farmers (Beneficiary will bear 50 % of the costs)
Training by CeCPA	Meal / per-diem allowance for trainee	1,000	2,000 person·day	2,000,000	1000 farmers participate for two-day training.
	Training materials (trial and actual tanks)	50,000	14 sites	700,000	It will be implemented in 14 sites
			Total	72,700,000	

(6) Remarks based on the result of pilot project

- ◆ There were cases found in pilot project where beginners of plastic sheet aquaculture did not feed properly so that fish did not grow well. Technical follow-up particularly on feeding practice must be provided.
- ◆ According to the rule, beneficiaries have to share a half of the total cost. However, if the project procures half amount of seeds and feeds in advance, they may not be buy additional 50%. There is a possibility that aquaculture could not be continued because of no procurement of additional feed. Therefore, the beneficiaries will be requested to pay the half in advance at the second rearing cycle.
- ◆ The length of plastic sheet tanks is to be 4m in general. However, the width can be adjusted flexibly considering farm location and desired production scale of farmers.

5.3.4 Project for development of quality Tilapia broodstock by selective breeding

(1) Background of the project

In Benin selective breeding of Tilapia has not been carried out. Natural breeding has been applied in the Tohonou seed production center after local strain of the ex- Godomey station was replaced with imported one from Burkina Faso in 1990's. Continuation of natural breeding in ponds has caused degradation of the genetic quality and downgraded the size of broodstock, which is about 200 to 250g at present. Moreover, it can also be observed that some broodstock reared by private seed producers weigh only less than 100g. Juveniles produced from these fish show slow rate of growth and do not reach to the commercial size, even if they are reared relatively long time, since they inherit the inferior genetic characters. This is one of the big obstacles for expansion of Tilapia aquaculture.

Grow-out of quality broodstock has been conducted at fisheries experimental station in Gabon these days. They carried out selective breeding among existing strain for 2-3 years, instead of introducing new strain. At the same time, they made effort for feed improvement. As the results it is reported that the size of broodstock has increased to be 400-700g for female and 600-1000g in male, and the productivity of seeds has been improved well (Overseas Fishery Cooperation Foundation of Japan). In Benin, since it would be possible to start with a similar process of experimental breeding, the project pursue development of quality broodstock strain through selective breeding with the priority selection criterion as the growth rate during juvenile stage. Furthermore, fostered quality broodstock will be provided for seed producers through regional broodstock management centers (distribution centers) in order to improve the productivity and quality of local seeds.

(2) Objectives and Indicators

Short term objective: Quality broodstock of Tilapia is maintained to be distributed locally

Middle and long term objective: Quality of seeds produced from the distributed quality broodstock is improved

Indicator: Number of Tilapia broodstock delivered from distribution centers

(3) Outcomes to be expected

- ◆ Quality of Tilapia broodstock is improved
- ◆ Skills of technician about management of broodstock are improved
- ◆ Quality of seeds is improved through breeding of quality broodstock

(4) Activities

1) Target area: Whole the county

2) Target group: The project does not set up any direct target group, because the main purpose is to improve broodstock quality. Among the people who have already engaged in seed production, those who would like to replace broodstock will be indirect target group.

3) Major activities

Stage 1: Development and examination of quality broodstock strain

Quality broodstock strain of Tilapia will be identified and produced at the Tohonou seed production center by selective breeding method, and reared at local distribution centers. The initial Tilapia breeders are to be selected among existing Tilapia broodstock reared at the Tohonou seed production center. Juveniles raised from these breeders are stocked in concrete water tank, and those showing faster growth rate will be selected after two to three months of rearing. They are reared continuously with further selection to be done every 3 months according not only to the size but also shape and body color in order to grow-out as F-1. Likewise, selective breeding is continued up to F-3, and there after they are maintained as the standardized quality broodstock. Thereafter quality of seeds bred from thus produced F-3 shall be compared with those bred from existing broodstock. When the superiority of the F-3 is verified, the project will distribute them nationwide.

Stage 2: Distribution of the quality broodstock to seed producers

A total of 4 distribution centers (broodstock management centers) will be established, i.e., two in

southern region, one each in middle and northern regions, considering effective delivery of broodstock for nationwide seed producers. The Tohonou seed production center will provide technical training including OJT for technicians in each distribution center. Each center shall continue breeding of the standardized quality broodstock, and then distribute them for seed producers.

4) Project period: 5 years

During the first 2.5 years, quality broodstock are to be produced through selective breeding and verification of their superiority. From the latter half of the second year to the third year, technicians of the candidate distribution centers will be trained and the centers will be established, following which distribution of broodstock will be started partly. In the fourth year, delivery of the broodstock to seed producers will be conducted practically and the seeds produced will be monitored and evaluated.

Table 5-5. Work plan of the project for development of quality Tilapia broodstock by selective breeding

Stage	Year																					
	1				2				3				4				5					
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q		
Rearing experiment for growth of existing tilapia broodstock in Tohonou	█																					
Breeding of selective broodfish as F1 on the basis of result of growth experiment		█																				
Breeding of the selected fish as future broodstock by selection continuously until third generation (F3)					█																	
OJT for technicians of regional broodstock management center (4 centers will be established)						█																
Facilities construction and equipments installation are promoted for 4 regional centers.							█															
Delivery of F3 broodfish as standardized quality fish to every regional center											█											
Monitoring of standardized quality broodfish management in each center													█									
Delivery of standardized quality broodfish to seed producing farmer through regional distribution center													█									
Monitoring and evaluation of seed quality																	█					

(5) Inputs

- 1) One expert on breeding and broodstock management (3MM_4 year)
- 2) Inputs to the project are estimated as follows.

Table 5-6. Cost estimation of the project for development of quality Tilapia broodstock by selective breeding

Activities	Items	Unit Price	Quantity	Amount	Remarks
Cost for selective broodstock breeding	Feed (50 kg x 20 months)	250	1,000 kg	250,000	Feed to rear 4000 fish for 20 months (fish weight during entire rearing period is estimated 50 g and fish are fed at 5 % feeding rate)
Rearing experiment and selection of breeders	Juvenile tilapia for selection as F1	40	4,000 fishes	160,000	Rearing experiment 2 times /500 fish x 4 sites
	A set of materials for fish rearing and experiment such as scoop net, scale, bucket, basin, etc	200,000	1 set	200,000	
	Preparation of concrete tank for fish nursing	500,000	1 set	500,000	
Preparation of regional distribution center	Preparation of ponds (dredging, reinforcement of dike, spraying lime etc)	1,000,000	8 ponds	8,000,000	
	Basin for selection, concrete tank for nursery	500,000	4 sets	2,000,000	
	Feed (200 kg x 20 months x 4 sites)	250	16,000 kg	4,000,000	Feed to rear 600 fishes in 4 sites during 20 months (fish weight during entire rearing period is estimated 400g and fishes are fed at 3 % feeding rate)
	OJT for technician of regional center	15,000	240 days	3,600,000	2 trainees are selected from each center. 8 person x 30 days x Per-diem/daily allowance 15000
	A set of materials for broodfish rearing and breeding such as scoop net, scale, bucket, basin, etc	200,000	4 set	800,000	
Distribution and monitoring of broodstock	Transportation fee for technician of the center for monitoring activities	20,000	48	960,000	Technicians of 4 centers will be engaged for 12 months.
					*Beneficiaries bear cost of transportation.
			Total	20,470,000	

(6) Remarks based on the result of pilot project

- Distinguish strictly male and female at their early development stage (repeat practice and master well)
- After the selection, isolate the candidate broodstock strictly and rear them in good conditions
- In order to keep good water condition and rearing environment, broodstock ponds must be dried completely and eliminate the fish left before introducing water
- Maintain good growth of fish through adequate feeding practice both in quality and quantity.
- Record daily data for proper rearing management (not only water temperature but also other water quality indicators)
- Apply proper sampling method in the examination of growth suitable for the experimental purpose
- Maintain significant amount of the standardized quality broodstock at the core center (Tohonou) in order to avoid inbreeding during continuous management (more than _500 individuals)

5.3.5 Project for improvement of pond aquaculture technologies

(1) Background of the project

Most of the existing fish ponds in Benin cannot be drained by gravity. In addition the shape and structure of ponds are often not suitable for harvest. There are, for example, remained stubs and flourishing water-weeds in ponds, or the size is too big or its shape is not designed well for fish harvest. In general partial harvest is conducted by using seine net or cast net. However, since it is impossible to catch all the fish in such ponds, remained Tilapias continue to self-breed, which causes a well-known problem of diminishing of the fish size. Furthermore, in addition to the lack of adequate equipment for the harvest such as scoop net and seine net of the suitable size, there is little information about proper utilization of the equipment and harvest technology. Those situations discourage farmers' efforts for harvest and there after aquaculture practice was abandoned in many cases.

Also, it was observed in existing ponds that different sizes of the fish seed tend to reduce production efficiency. The pilot project in this study showed that the survival rate of Clarias juveniles were significantly improved by culturing them with size selection in difficult hapa net during the first several weeks before stocking to ponds. In the case of Tilapia, the production efficiency can also be increased by size selection. It is recommended to weed out female fish which are matured and start spawning at smaller size of 50-60g.

(2) Objectives and Indicators

Short-term objective: Improved equipments for effective production are utilized well among fish farms.

Medium and long term objective: Productivity of existing aquaculture ponds improves.

Indicators: Number of fish farms which use improved equipments like hapa net, scoop net etc.
Number of fish farms which use drainage pump and seine net at the harvest.

(3) Outcomes to be expected

- Farmers can use necessary equipments at the harvest.
- Number of fish remained in pond after harvest will decrease.
- Aquaculture fish production of farmers will increase.
- Size selection of seeds and broodstocks becomes easy.
- Farmers understand the importance of size selection of fish, and the production efficiency improves.

(4) Activities

1) Target area: 60 cities

2) Target group: Existing and new fish farmers.

3) Major activities

To provide fish farmers and aquaculture groups with various small-scale equipment such as seine net for harvest, machineries like drainage pump with engine, scoop net and happa net used for size selection, temporary stocking of seeds and nursing juveniles, etc. A part of expenses will be paid by the beneficiaries. At the same time, the project provides instruction about their proper utilization, and improves production efficiency of ponds through appropriate and effective techniques on harvest and fish production.

- Provision of rearing equipment like hapa net and scoop net etc. to the applicants with pay partly.
- Provision of harvesting equipment like drainage pump with engine and seine net etc. to the applicants with pay partly.
- Holding seminars in CeCPA regarding various topics like installation of juvenile selector and proper utilization of hapa net.

4) Project period: 2 years.

(5) Inputs

Cost estimation is as follow.

Table 5-7. Cost estimation of the project for improvement of pond aquaculture technologies

Activities	Items	Unit price	Quantity	Amount	Remarks
Distribution of tools to improve productivity (partially fare-paying)	Hapa net (2 m x 3 m)	30,000	5,000	75,000,000	1250 farmers x 4 hapa nets (Beneficiaries bear the half of the cost)
	Scoop net	10,000	2,500	12,500,000	1250 farmers x 2 nets (Beneficiaries bear the half of the cost)
Distribution of equipments for harvesting (partially fare-paying)	Pump	250,000 (50%)	180	45,000,000	Beneficiaries bear the half of the cost
	Seine net	400,000	300	120,000,000	Beneficiaries bear the half of the cost
Training in CeCPA	Per-diem/daily allowance for lectures	15,000	120	1,800,000	60 staffs x 2 days
	Transportation fee and per-diem/daily allowance are not provided to beneficiaries who is provided materials and machines				
			Total	254,300,000	

(6) Remarks based on the results of pilot project

- Provision of equipment shall be implemented equally to whole the country avoiding concentration to the certain communes
- Upon selection of distribution sites, uniformed criteria shall be applied in order to prevent complaints among fish farmers
- Upon procurement of equipment for delivery, it would be realistic to import cheap and common aquaculture equipment (such as hapa net and scoop net) from Southeast Asian countries where freshwater aquaculture has been extended, since they are difficult to obtain or expensive in Benin.
- Regarding the equipment like the hapa net etc, which bulk import are practical, half pay rule of the applicants shall be kept strictly, and the collected fee would be used for supplement of the next purchase.

5.3.6 Project for feed improvement and extension

(1) Background of the project

Feeding with high quality feeds is important to grow-out fish. In Benin, however, fish farms using compound feeds are still limited in number although some farmers have fed on fish with agriculture by-product like rice bran or powdered mix feeds in which the composition is recommended by the Department of Fishery (DOF), Benin. The reason why artificial feeding has not been popular yet would be due to the difficulty to obtain quality feed at reasonable price. At present artificially blended pellets for fish are marketed partly by NGO (SONGHAI) and the university (Abomey-Calavi) targeting mainly for the demand from donor agencies. However in general, quality of those pellet feeds is insufficient despite the price is too high for small-scale farmers to purchase.

Fish farmers are scattered in rural areas. Considering of the transportation cost, it would be practical to produce pellet feeds at each farm using locally available materials rather than establishment of feed manufacturing center (feed factory). It is also considered to produce various on-farm blended feeds such as crumble, paste and boiled feeds using adequate raw materials depending on the site characteristics. This project is to develop high performance feed at low cost using the materials available in ordinary farmers, and then to extend various types of feeds to rural fish farmers coupled with skills to make pellet, paste and boiled feeds.

(2) Objectives and Indicators

Short-term objective: Farmers who practice aquaculture with proper feeding increase.

Medium and long term objective: Productivity of fish farmers improves.

Indicator: Number of farmers who practice aquaculture with proper feeding.

(3) Outcomes to be expected

- Fish farmers understand the characteristic of compound feeds, and merit and demerit on feeding aquaculture.
- Criteria for choosing suitable feed for rural aquaculture are established.
- Percentage of feed cost is decreased by implementing pellet feeding
- Unit price of fish meat as an indicator of production efficiency is decreased comparing to the case that conventional feeds are used.
- Utilization of agriculture by-product is promoted

(4) Activities

1) Target area: Whole country

2) Target group: Existing fish farmers

3) Major activities:

Stage1: Development of compound feeds and design of composition

For each aquaculture development potential zone in north and south regions respectively, available feed materials are listed and analyzed at domestic laboratories, and examined their possibility as compound feed materials. In this case, if there is a doubt in the accuracy of assay, it is recommendable to carry out cross-check analysis in overseas competent organizations. Based on those procedures, alternative feed plans will be prepared considering the required nutritional components depending on the development stages of fish and by species (Tilapia and Clarias). Then those feed plans are verified through comparative rearing experiments regarding the feed efficiency by each developmental stage as well as production cost, so that, proper composition of feed materials is determined for each potential zone, and finally the best one is selected as the recommendable feed. The performance of feeds is also noticed for farmers who don't introduce pellet but using other types of feeds such as paste and boil.

Stage2: Extension of developed feeds

Thus developed feeds are extended among fish farmers through various seminars and on-farm demonstration. Farmers who are willing to apply pellet are selected, and practical training of making pellets are carried out in CeCPAs. The practical training seminar is planned for 10 participants per

time and 2 times per each commune. In each seminar a manual-type pellet-processing machine (meat chopper) is rent to a model farmer who has been applying pellets, and CeCPAs promote the pellet making activities and feeding aquaculture at the time of farm monitoring. Various types of feed and feeding method are demonstrated in seminar, and knowledge on feed characteristics is disseminated.

4) Project period

Project period is 4 years in total. Two (2) years for determination of feed composition based on the investigation of locally available feed materials coupled with comparative growth experiments, and 2 years for introduction and extension among fish farmers.

Table 5-8. Work plan of the project

Stage	Year 1				Year 2				Year 3				Year 4			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Survey of locally available feed ingredients	█															
Set the composition and manufacture compound feeds for trial		█														
Feeding trial (rearing experiments) to compare performance of feed			█													
Evaluation and determination of recommendable feeds on the basis of results of experiments							█									
Training on feed manufacturing in CeCPA									█				█			
Introduction and guidance for farmers with monitoring and follow-up by CeCPA										█				█		

(5)Inputs

1) Experts on improvement and extension of compound feed (1 person, 6 MM x 2 years and 3 MM x 2 years)

2) Cost estimation is as follow.

Table 5-9. Cost estimation of the project for feed improvement and extension

Activities	Items	Unit price	Quantity	Amount
A.Feed development				
survey of materials	Per-diem/daily allowance for driver	10,000	20 days	200,000
	Materials and ingredients	2,000	40 samples	80,000
	Nutritional analysis (Protein, lipid, carbohydrate and amino acid composition)	120,000	40 samples	4,800,000
	Manufacture of trial feeds			
	Material A	400	300 kg	120,000
	Material B	300	300 kg	90,000
	Material C	200	600 kg	120,000
	Material D	150	1,000 kg	150,000
	Material E	100	1,000 kg	100,000
	Pelleting machine(meat chopper)	1,500,000	1	1,500,000
	Mill	800,000	1	800,000
	Shifter (for crumble feed)	1,200,000	1	1,200,000
Rearing experiment	Fish seed for trial (Tilapia) 500 fishes x 4 groups x 8 times	40	16,000	640,000
	Fish seed for trial (Clarias) 500 fishes x 4 groups x 8 times	100	16,000	1,600,000
	Equipment set for culture (scoop net, scale, bucket and basin etc.)	200,000	1 set	200,000
	Pond arrangement (dredging, reinforcement of bank, lime etc.)	200,000	8 ponds	1,600,000
B.Introduction and extension				
Introduction	Meat chopper (manual)fixed on bench	30,000	78 farmers	2,340,000
	Set of bucket, bowl, basin and hand mixer	20,000	78 farmers	1,560,000
	Ingredients for feed manufacturing (for one time trial) 200 kg x 78 farmers	300	15,600 kg	4,680,000
Training	Number of trainees 10 persons /time		10 trainees	780,000
	Time (1 days x 39 cities x 2 times)		78 times	
	Meal allowance for trainees	1,000		
	Site management (including honorarium for lecturer)	15,000	78 times	1,170,000
Follow-up	Banner	30,000	78 times	2,340,000
	Transportation fee for monitoring by CeCPA	20,000	39 sites	9,360,000
				x 12 months
				Total 35,430,000

(6)Remarks based on the results of pilot project

- Analysis of feed materials is expected to be done at Abomey-Calavi University, but it is recommended to carry out cross-check in another domestic laboratory, if necessary.
- Culture experiments will be practiced at the Tounu seed production center in principle. However other experimental facilities like universities and NGO (CREDI) will also be considered from the view to develop human resources.
- Methods of experiments and management about rearing experiments shall be discussed very well in order to secure biological accuracy
- Instruct counterparts to understand methods of sampling and data analysis
- On the evaluation of feed performance, cost (unit price) of fish meat is given priority than FCR.
- Adequate feed shapes shall be considered when feeds are introduced practically to fish farmers.

5.3.7 Project for training of catfish seed producing farmers

(1) Background of the project

In target areas of farmer-to-farmer training on Clarias culture, namely Ouémé and Plateau districts, number of seed producers (core farmers) to be established is planned to be 14 in total during 3 years period (3 farmers in the 1st year, 5 in the 2nd year and 6 in the 3rd year). They will be suppliers of Clarias seeds in the target areas. On the other hand, the demand for Clarias seeds is expected to increase largely according to the increasing numbers of fish farmers when another action plan 'Project for aquaculture extension through farmer-to-farmer training' proceeds forward. Taking into account the number of farmers who will be fostered through the farmer-to-farmer training and start Clarias aquaculture spontaneously, more than one million of Clarias seeds will be demanded annually after the fourth year (Table 5-10).

Table 5-10. Estimate of Clarias seed demand after the farmer-to-farmer training

After start the training	2nd year	3rd	4th	5th	6th
Group 1	270	243	243	243	243
Group 2	-	450	405	405	405
Group 3	-	-	540	486	437
Number of farmer in total	270	693	1,188	1,134	1,085
Expected seed demand	270,000	693,000	1,188,000	1,134,000	1,085,000

Conditions for estimation

* It is supposed that 90 % of training participants start fish culture at the 1st year after the training, continuously 90 % of them practice fish culture after the 2nd year.

** All farmers continue fish culture after the 3rd year.

*** Farmer buy 500 seeds 2 times per year

Relatively large-scale Clarias seed producers having progressive techniques in Benin are producing about 5,000 seeds per rearing cycle and 4-5 cycles annually. Accordingly, production capacity per year per producer is calculated to be about 20,000 seeds, which means that production of 14 core farmers could not satisfy the aforementioned demands. In order to cope with the expected deficit of seed supply, it is needed to foster additional seed producers and to formulate a Clarias seed supply system in each zone. This project selects candidate seed production farmers who have motivation, sufficient results of fish production and necessary facilities, and provides them with Clarias seed production techniques and relevant supportive facilities.

(2) Objectives and Indicators

Short-term objective: Clarias seeds are secured in quantity to meet the demands of fish farmers in Benin.

Medium and long term objective: Aquaculture production of Clarias increases in whole areas of the country

Indicators: Number of Clarias seed producing farmers (Actual increase in number)
Production of Clarias seeds per farmer (Efficiency of seed production)

(3) Outcome to be expected

- Amount of seed supply is increased, and fish farmers are able to procure necessary amount of seeds.
- Price of seed will be normalized and stabilized.
- Quality of seed is improved.

(4) Activities

1) Target area:

Whole country, but mainly for target districts of farmer-to-farmer training such as Atlantique, Mono, Couffo, Ouémé, Plateau and Zou.

2) Target group

Fish farms to be selected among existing medium- to large-scale entities, having motivation for Clarias seed production and necessary facilities

3) Major activities

- Make a list of farmers who have acquired Clarias seed production techniques.
- Implement seed production training (the site will be NGO SONGHAI; some lecturers are invited from other organizations).
- Support improvement of seed production facilities
- Procure Clarias broodstock from existing farmers, and provide them for new seed production farmers.
- Support introduction of basic seed production techniques to new farmers, i.e., acceleration of maturation and induction of ovulation using hormonal agents.
- Implement training on hatchery management and early fish rearing techniques.
- Support improvement of seed transportation techniques.
- Support farm management.
- Improve seed production efficiency through verification of available techniques together with existing Clarias seed producers. Training of third country's experts is expected.

4) Project period: 3 years.

(5)Inputs

1) Expert on Clarias seed production technique (1 person, 2MM x 1)

(For technical evaluation and advice, it is recommendable to recruit the experts from third country where Clarias seed production techniques are established at commercial level

2) Cost estimation is shown as follows.

Table 5-11. Cost estimation of the project for training of catfish seed producing farmers

Activities	Items	Unit price	Quantity	Amount	Remarks
Training	Training acceptance (SONGHAI)	20,000	700 person and day	14,000,000	10 persons x 10 times x 7 days
	Dispatch of instructors (including transportation fee)	25,000	70 days	1,750,000	10 trainings (7 days/ times) for 3 years
(consignment contract)	Transport	20,000	100 persons	2,000,000	
	Facility construction	500,000	100 persons	50,000,000	Farmer pays half-price in 500,000 FCFA as construction cost total.
Support of production facilities	Tank for brood-stock		2 tanks (2 m x 3 m x 1.2 m)		
	Hatching tank		1 tank (1 m x 2 m x 0.5 m)		
	Tank for larval fish		1 tank (1 m x 2 m x 0.5 m)		
	Tank for juvenile fish		2 tank (2 m x 3 m x 1.0 m)		
	Cement - mortar brick structured				
	Elevated water reservoir tank	300L	1 tank (platform 1.5 m x 1.5 m x 3 m)		
	Open shed				
Support of materials and equipments for production	Broodstock (including cost of transportation)	2,000 FCFA/kg	4,500 kg	9,000,000	Brood-stock (1.5 kg x 30 fishes) x 100 farmers
	(Beneficiaries bear the cost of feed for broodstock)				
	Feed for nursing (for fry and juvenile)	800 FCFA/kg	5,000 kg	4,000,000	50 kg x 100 farmers
	Set of equipments (hormone, syringe, dissection kit, mortar and scoop net, etc)	50,000	100 persons	5,000,000	1 set x 100 farmers
	Oxygen bottle and regulator	50,000	100 persons	5,000,000	1 set x 100 farmers
Dispatch third country expert	Traveling cost and other expenses for invitation	8,000,000	1 person	8,000,000	
	Daily allowance and accommodation fee	150,000	60 person·day	9,000,000	
			Total	107,750,000	

(6) Remarks based on the results of pilot project

- Target group shall be selected in an objective way in order not to arise complaint among farmers.
- Clarias seeds produced by target group shall be sold in priority for farmers who participated in training
- Target group shall cooperate to maintain adequate price of seeds.

5.3.8 Project for aquaculture extension through farmer-to-farmer training

(1) Background of the project

In Benin, farmers had rarely have opportunities to learn aquaculture technology. This fact was one of the causes of difficulty of aquaculture extension. NGO (SONGHAI), as a local training institution irregularly carries out aquaculture training with pay. However, it is uneasy for farmers to participate in the training because the participation fee is expensive.

In rural areas, it is common that information including aquaculture technology is transferred from person to person and/or via CeCPA. Therefore, it deems to be more effective to use such ways of information transfer among farmers when the plan promotes technical extension and introduction of technology to new farmers. As a result of the survey to farmers who actually started aquaculture recently, most of farmers started aquaculture by imitating their neighbors' examples or being recommended by neighbors and/or friends. It deems to be possible to implement practical aquaculture extension work by training core farmers who play key roles of technical transfer in the areas and by promoting extension activities through the farmer-to-farmer training. This project aims to train core farmers in order to obtain technological and business knowledge and management, and promote technical transfer to other farmers and support aquaculture activities through the farmer-to-farmer training.

(2) Objectives and Indicators

Short-term objective: Farmers who are trained by core farmers practice aquaculture.

Medium and long term objective: Number of fish farmers increases according to the core farmers as the knowledge centers

Indicators: Number of farmer who carries out aquaculture after participation to the trainings (Number of farmer who newly starts and fallow farmer who restarts aquaculture)

(3) Outcomes to be expected

- Fish farmers who acquired aquaculture technology through farmer-to-farmer training start aquaculture.
- Means of technical transfer about practical aquaculture diversify among farmers.
- Farmers interested in aquaculture are easily access to aquaculture technical information.
- Farmers can be consulted and resolve problems nearby and easily when some problems arise concerning aquaculture.
- Deals and exchanges of seeds and broodstock are activated among fish farmers.

(4) Activities

Tilapia culture

1) Target area: Atlantique, Mono, Couffo, Ouémé, Plateau and Zou (43 cities of 6 districts)

2) Target group: Fish farmers who practiced aquaculture before but ceased the activities and person who wants to start fish farming newly

Clarias culture

1) Target area: Ouémé and Plateau (14 cities of 2 districts)

2) Target group: Existing fish farmers who want to start Clarias culture and person who wants to start the same newly

3) Major activities:

The target species are Tilapia and Clarias. Number of core farmers as the site for training implementation in the target area will be 29 for Tilapia culture and 14 for Clarias culture in a total of 3 years period. In each site, training is held for 5 times with 20 participants per time.

Before the farmer to farmer training is carried out, it is necessary to train core farmers who can take leadership in the training as instructors. During the first 3 years of the project, 1 to 4 candidate core farmers are selected from each target district every year in proportion to the number of fish farmers, and they are fostered to be seed production farmers through technical training on aquaculture and seed production (This training is called as "Core farmer training"). Thus, seed producers fostered as core farmers are to train other farmers in terms of "farmer to farmer training" from the next year.

Table 5-12. Number of sites for implementation of farmer-to-farmer training

District	Number of city	Number of fish farmer (2008)	Target species	Number of training site (core farmer)			Total
				Group 1	Group 2	Group 3	
Atlantique	8	320	Tilapia	2	3	3	8
Mono	6	74	Tilapia	1	1	2	4
Couffo	6	39	Tilapia	1	1	2	4
Zou	9	54	Tilapia	1	1	2	4
Oueme	9	302	Tilapia	1	2	2	5
			Clarias	2	3	4	9
Plateau	5	73	Tilapia	1	1	2	4
			Clarias	1	2	2	5
Total	43	862	Tilapia	7	9	13	29
			Clarias	3	5	6	14
			Total	10	14	19	43

At the same time, the project provides broodstocks with good strain and technical guidance for improvement of seed production to core farmers, and also aims to empower them as bases for seed supply. In addition, even after the training finished, the project supports necessary materials including seeds for the initial investment in order to encourage ex-participants to practice aquaculture. These activities are as follows.

- ① Selection of core farmers
- ② Implementation of core farmers training (1st-3rd year)
- ③ Enhancement of seed production capacity of core farmers (1st-3rd year)
- ④ Construction of training facilities (including blackboard, desk, and chair, etc.)
- ⑤ Announcement of training information by various means
- ⑥ Selection of trainees
- ⑦ Implementation of training
- ⑧ Support for ex-participants to encourage practice of aquaculture
 - a. Ex-participants of Tilapia culture training _Financing from the supporting fund for pond digging
 - b. Ex-participants of Clarias culture training_
 - (1) Financing from the supporting fund for pond digging
 - (2) Provision of materials for making rearing facility with pay (plastic sheets or backyard tank)
- ⑨ Provision of seeds etc. with pay to ex-participants who satisfied necessary conditions to practice aquaculture
 - a. Ex-participants of Tilapia culture training_ Distribution of Tilapia seeds, feeds and poultry manures for once in a culture cycle.
 - b. Ex-participants of Clarias culture training _ Distribution of Clarias seeds and feeds for once in a culture cycle.
- ⑩ Regular technical guidance by CeCPA fishery extension officer for fish farmers after completion of the training as a follow-up.

4) Project period: 5 years in total. (1 year for preparation, 3 years for training implementation, 1 year for monitoring and evaluation.)

Table 5-13. Work plan of the project (Both Tilapia and Clarias)

Stage	Year 1				Year 2				Year 3				Year 4				Year 5			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Selection of core farmers(1 farmer per commune)	█					█				█										
Implementation of core farmer training (1st to 3rd year)		█				█				█										
Enhancement of seed production capacity of core farmers (1st to 3rd year)			█																	
Construction of training facilities (including blackboard, desk, and chair, etc.)				█				█				█								
Publicity, advertisement for subscription of training			█					█				█								
Selection of training participants				█				█				█				█				
Implementation of training						█				█				█						
Distribution of materials and fish seeds etc.to training								█				█				█				
Technical guidance by core farmers for digging pond								█				█				█				
Regular monitoring and follow-up by fishery extension staff of CeCPA									█											

The next table indicates frequency of training to be implemented and estimated number of participants. Candidate core farmers to be selected each year have to participate in aquaculture and seed production training (core farmers training) held at NGO (SONGHAI) in which some local resource persons are invited from outside as lecturers. They become trainers and carry out the farmer-to-farmer training in the next year.

Table 5-14. Number of sites for farmer-to-farmer training and estimated number of participants

Training for tilapia culture		Group 1	Group 2	Group 3	Total
	1st year	2nd	3rd	4th	
Core farmer training	From 6 districts	7 farmers	9 farmers	13 farmers	29 farmers
Farmer-to-farmer training	Sites	7 sites	9 sites	13 sites	
	Number of farmers	20 farmers	20 farmers	20 farmers	
	Frequency	5 times	5 times	5 times	
	Total number of participants	700 farmers	900 farmers	1300 farmers	2,900 farmers
Training for clarias culture		Group 1	Group 2	Group 3	Total
	1st year	2nd	3rd	4th	
Core farmer training	From 2 districts	3 farmers	5 farmers	6 farmers	14 farmers
Farmer-to-farmer training	Sites	3 sites	5 sites	6 sites	
	Number of farmers	20 farmers	20 farmers	20 farmers	
	Frequency	5 times	5 times	5 times	
	Total number of participants	300 farmers	500 farmers	600 farmers	1,400 farmers

As for Tilapia culture, 29 core farmers are to be fostered in 43 communes and a total of 2,900 farmers participate in farmer-to-farmer training until the 4th year. Regarding Clarias culture, 14 core farmers are to be fostered in 14 communes and a total of 1,400 farmers participate in the farmer-to-farmer training. Of those participants, 80% of farmers in tilapia culture and 90% of farmers in Clarias culture are expected to practice aquaculture. The project contributes to increase of 3,580 aquaculture

population in total (2,320 Tilapia culture farmers and 1,260 Clarias culture farmers).

(5)Inputs

- 1) Expert on aquaculture extension (1 person, 4MM x 5 years)
- 2) Cost estimation is as follow.

Table 5-15. Cost estimation of the project for aquaculture extension through farmer-to-farmer training (Tilapia culture)

Tilapia culture						
Activities	Items	Unit price	Quantity	Amount	Remarks	
Core farmers training	Training expenses (consignment contract with SONGHAI)	20,000	580 person · day	11,600,000	29 candidates x 20 days	
	Honorarium for instructor (including transportation fee)	25,000	30 days	750,000	10 days/year (for 3 years)	
	Transportation fee	20,000	29 persons	580,000	29 candidates	
Improvement of production facility for core farmers	Broodstock distribution (including transportation fee) (Beneficiaries bear the cost for pond arrangement)	2,000 FCAF/kg	300 fishes x 29 persons	4,350,000	Supply of 300 broodstocks (average 250 g/fish) per core farmer.	
	Feed for broodstock (Beneficiaries bear the feed for seed because they will take profit by the seed sales)	200 FCAF/kg	19,575 kg	3,915,000	Broodstock (250 g x 300 fishes) are supposed to be fed 5 % of biomass during 180 days.	
	Construction of training facilities (including the blackboard, the desk and the chair etc.)	300,000	29 sites	8,700,000	The facilities are constructed in 29 core farmers sites at first training. (Beneficiaries will take responsibility for maintenance of facilities)	
Farmer-to-farmer training	Publicity by radio (at first training)	21,000	29 sites	609,000	3000 FCAF / times x 7 times x 29 sites	
	Banner (for every training)	30,000	145 times	4,350,000	29 sites x 5 times	
	Honorarium for instructor	15,000	580 days	8,700,000	145 trainings x 4 days	
	Meal for participants	1,000	11,600 person · day	11,600,000	145 trainings x 4 days (20 participants every time)	
	Stationery (notebook and pencil etc.)	2,000	2,900 persons	5,800,000	145 trainings (20 participants every time)	
	Materials for practice (net, rope and wire)	10,000	2,900 persons	29,000,000	145 trainings (20 participants every time)	
Materials support for participant	Seed	20	1,160,000 fishes	23,200,000	500 seeds are provided for 80 % of 2,900 participants in 145 trainings. (seed cost is estimated 20 FCAF because beneficiaries bear half of the cost.)	
	Chicken manure	4,000	2,320 farmers	9,280,000	800 FCAF x 5 bags are provided to participants who purchase seeds.	
	Feed	100	469,800 kg	46,980,000	Necessary feed amount is estimated 2020 kg each participant on the basis of following conditions. (the fishes grow 150 g with FCR 3, survival rate is supposed to be 90 % until harvest size) It is provided to 80 % of 2,900 participants in 145 trainings. (Feed cost is estimated 100 FCAF because beneficiaries bear half of the cost)	
Support for digging pond	Fund for digging pond	2,000	290,000 m ²	580,000,000	50 % of participants in 145 trainings is supposed to be applicant to request digging pond. An applicant can be furnished with fund for digging 200 m ² pond. Beneficiaries should take responsibility repay the 50 % of loan. The cost of digging is estimated 2,000 FCAF per m ² .	
*Cost of regularly technical guidance tour by SPH is not included, because it is routine work.			Total	749,414,000		

Table 5-16. Cost estimation of the project for aquaculture extension through farmer-to-farmer training (Clarias culture)

Clarias culture						
Activities	Items	Unit price	Quantity	Amount	Remarks	
Core farmers training	Training expenses (consignment contract with SONGHAI)	20,000	280 person * day	5,600,000	14 candidates x 20 days	
	Honorarium for instructor (including transportation fee)	25,000	30 days	750,000	10 days/year (for 3 years)	
	Transportation fee	20,000	14 persons	280,000	14 candidates	
	Construction of the seed production	1,000,000	14 persons	14,000,000		
Improvement of production facility for core farmers	Tank for broodstock		1 tank (1 m x 1 m x 0.5 m)			
	Hatching tank		1 tank (1 m x 1 m x 0.5 m)			
	Tank for larval fish		1 tank (1 m x 1 m x 0.5 m)			
	Tank for juvenile fish		2 tanks (1 m x 1 m x 0.5 m)			
	Above facilities are built by cement-mortar brick					
	Feed for broodstock	200 FCFA/kg	3,024 kg	604,800	Broodstock (800 g x 30 fishes) are supposed to be fed 5% of biomass during 180 days.	
(Beneficiaries should take responsibility for procurement of broodstock and feed for seed because they will take profit by the seed sales)						
Farmer-to-farmer training	Construction of training facilities (including the blackboard, the desk and the chair etc.)	300,000	14 sites	4,200,000	The facilities are constructed in 14 core farmers sites at first training. (beneficiaries will take responsibility for maintenance of facilities)	
	Publicity by radio (at first training)	21,000	14 sites	294,000	3000 FCFA times x 7 times x 14 sites	
	Banner (for every training)	30,000	70 times	2,100,000	14 sites x 5 times	
	Honorarium for instructor	15,000	280 days	4,200,000	70 times x 4 days	
	Meals for participants	1,000	5,600 person * day	5,600,000	70 times x 4 days (20 participants each training)	
	Stationery (notebook and pencil etc.)	2,000	1,400 persons	2,800,000	70 times (20 participants each training)	
	Materials for practice (net, rope and wire)	10,000	1,400 persons	14,000,000	70 times (20 participants each training)	
	Seed	50	630,000 fishes	31,500,000	500 seeds are provided for 90% of 1,400 participants in 145 trainings. (seed cost is estimated 20 FCFA because beneficiaries bear half of the cost)	
Materials support for ex-participants	Feed	125	504,000 kg	63,000,000	Necessary feed amount is estimated 400 kg each participant on the basis of following conditions. (the fishes grow 500g with FCR 2, survival rate is supposed to be 80% until harvest size) It is provided to 80% of 1,400 participants in 145 trainings. (Feed cost is estimated 125 FCFA because beneficiaries bear half of the cost)	
	a Support by fund for digging pond	2,000	84,000 m ²	168,000,000	30% of participants in 70 trainings is supposed to be applicant to request digging pond. An applicant can be furnished with fund for digging 200 m ² pond. Beneficiaries should take responsibility repay the 50% of loan. The cost of digging is estimated 2,000 FCFA per m ² .	
Support for digging pond or culture tank (select between a, b and c)	b Plastic sheets and wood	30,000	420 persons	12,600,000	Plastic sheet is provided to 30% of participants. (Material unit price is estimated 30,000 FCFA as beneficiaries bear half of the cost)	
	c Cement-mortar brick	30,000	420 persons	12,600,000	Materials for construction are provided to 30% of participants. (Material cost is estimated 30,000 FCFA as beneficiaries bear half of the cost)	
				Total	342,128,800	

*Cost of regularly technical guidance tour by SPH is not included, because it is

(6) Remarks based on the results of pilot project

- Since the technical bases and socio-economic conditions behind the aquaculture development needs are different due to the locality, it is important to consider local characteristics of target communes upon preparation of the training curriculum. (However, basic training materials and textbooks will be the ones prepared by action plan 5.3.9.)
- Strict account management is required for delivery of seeds and feeds in order not to be claimed from beneficiaries who have to pay half of the cost.
- Environmental consideration is necessary when new farmers select sites and excavate aquaculture ponds. Hence the curriculum on this subject should be included in the farmer-to-farmer training.
- It is recommended that fishery extension officer of CeCPA continues monitoring as the follow-up until fish farmers harvest the fishes in order to secure the sustainability.
- In case that some fish farmers discontinue aquaculture, the causes should be analyzed and fed them back to the next training.
- Establishment of farmers' network organization is encouraged, because it is expected to be beneficial for cooperation for fish marketing after harvest and procurement of seeds.

5.3.9 Project for development of training materials on aquaculture

(1) Background of the project

“Aquaculture guide book in Benin” edited by JICA expert in 2006 has been utilized for various trainings. On the other hand, aquaculture methods in Benin vary locally, and measures for the technical guidance should match with fish species, local environment and different purposes of harvest. From this aspect, a comprehensive textbook corresponding to these various issues has not been prepared yet. Therefore, it is highly required to develop textbook covering technical issues systematically according to target species and type of aquatic environment. Moreover, there are strong needs on preparation of visual teaching materials such as flip chart with many illustrations and video, which enhance effect of training particularly in rural areas where percentage of illiterate people is high. In this project, a series of teaching materials on aquaculture extension are prepared and distributed to CeRPA and other relevant organizations in nationwide. These materials are used in trainings and also contribute to enlightenment for those who interested in aquaculture.

(2) Objectives and Indicators

Short-term objective: Trainings are implemented using teaching materials for aquaculture extension.

Medium and long term objective: Aquaculture technology is improved and the productivity increases.

Indicators: Number of teaching materials distributed for extension and frequency of training using the materials

(3) Outcomes to be expected

- Teaching materials for aquaculture extension are prepared and distributed to CeRPA and CeCPA.
- The prepared teaching materials for aquaculture extension are utilized in the trainings.
- People who are interested in aquaculture easily accesses to technical information.

(4) Activities

1) Target area: Whole country

2) Target group: Existing fish farmers and person who wants to start fish farming newly

3) Major activities:

- Categorize extension target
- Identify technological issues according to target species and aquatic environment
- Preparation of the aquaculture guide book and seed production manual based on information consolidated
- Preparation of flip chart and video teaching materials taking into account the use in trainings and seminars etc.
- Preparation of drawings about how to assembly necessary equipment (hapa net, fish selector and scoop net etc.)
- Use the above teaching materials in the trainings as well as in technical guidance, and feedback the results to improve them.

Materials to be prepared

- Aquaculture guidebook (Tilapia)
 - Aquaculture guidebook (Clarias)
 - Seed production manual (Clarias)
 - Flip chart (Tilapia culture) 1 set per target commune
 - Flip chart (Clarias culture) 1 set per target commune
 - Drawings showing how to assembly necessary equipment for aquaculture
 - Aquaculture guide video (Tilapia and Clarias)
- Preparation of the master video will be ordered to local company.

4) Project period: 2 years (1 year for preparation + 1 year for making, trial and feedback)

(5) Inputs

1) Expert on freshwater aquaculture (1 person x 6M/M x 2times)

2) Cost estimation:

Table 5-17. Cost estimation the project for development of training materials on aquaculture

A.Making of materials, printing and binding			
Name of materials	Unit price	Quantity	Amount
Aquaculture guidebook (Tilapia)	1,000	1,500	1,500,000
Aquaculture guidebook (Clarias)	1,000	1,500	1,500,000
Seed production manual (Clarias)	1,000	500	500,000
Flip charts (Tilapia culture) 1 set per target commune	30,000	39	1,170,000
Flip charts (Clarias culture) 1 set per target commune	30,000	14	420,000
Drawings show how to make necessary equipment for aquaculture	250	1,500	375,000
Aquaculture guide video (Tilapia and Clarias) The master video made by consigned contract company	300,000	1	300,000
B.Preparation of materials			
Items	Unit price	Quantity	Amount
Copy and print	30,000	24 months	720,000
Collection of refernce,pictorial book and literature	20,000	30	600,000
Copy machine	250,000	1	250,000
Computer	800,000	1	800,000
Scanner	50,000	1	50,000
Printer	50,000	2	100,000
Video camera	500,000	1	500,000
Record media set (Video and CD etc.)	50,000	1	50,000
Office equipments and supplies (Copy papers, pens and files, etc.)	20,000	24 months	480,000
Necessary materials for sample preparation (Hapanet, fish selector and scoop net etc. And net fabric, set of thread, needles, woods and wires)	200,000	1	200,000
		Total	9,515,000

(6)Remarks based on the results of pilot project

When making materials, practical data collected directly from the fields should be more important than those shown in existing (selling) aquaculture manuals and/or scholar's thesis.

5.3.10. Project for capacity building of fishery extension officer

(1) Background of the project

Number of fishery extension officer allocated for a total of 77 CeCPAs nationwide is reached more than 200 after mass employment of government officers in 2007. Supporting system for the extension activities has been improved such as provision of motorbikes for technical guidance and deployment of vehicle (pick-up). However, field experience of the extension officer who carry out on-site extension activities is insufficient, and they haven't acquired practical technology and know-how yet. MAEP understands well this situation and implements its own education program for extension officer. However, since this program has just started recently, sufficient outcomes have not attained yet. This project is to support the program of MAEP so as to improve efficiency of fishery extension activities in rural areas.

(2) Objectives and Indicators

Short-term objective: Fishery extension officer can teach aquaculture technologies appropriately.

Medium and long term objective: Productivity of existing fish farmers is increased and new farmers start aquaculture.

Indicators: Frequency of farm visit of fishery extension officer and frequency of inquiry from fish farmers

(3) Outcomes to be expected

- Trainings (lectures and practices) for fishery extension officer are carried out.
- Frequency of fishery extension officer's visit to fish farmers increases.
- Good relationship is formulated between fishery extension officer and fish farmers.
- Fish farmers acquire appropriate aquaculture technology.
- Aquaculture productivity of fish farmers is enhanced

(4) Activities

1) Target area: Whole country

2) Target group: All fishery extension officer of CeRPA and CeCPA (299 officer as of 2007)

3) Major activities:

- ① Prepare a training program for fishery extension officer to be implemented at each CeRPA in cooperation with the DOF and nationwide 6 CeRPAs.
- ② Invite lecturers for the training and prepare teaching materials.
- ③ Finalize the actual training procedures in cooperation with fish farmers who offer the place for practice, and prepare necessary equipment and materials.
- ④ The lectures of training visit CeRPA and implement 10 days on-site training twice

4) Project period: 1 year

(5) Inputs:

Cost estimation is as follows.

Table 5-18. Cost estimation of the project for capacity building of fishery extension officer

Items	Unit price	Quantity	Amount	Remarks
Honorarium for lecturers	30,000	240	7,200,000	10 days/time x 2 times x 6 sites x 2 persons (including accommodation fee)
Per-diem/daily allowance for driver	10,000	120	1,200,000	10 days/time x 2 times x 6 sites x 1 person
Per-diem/daily allowance for fishery extension staff	15,000	4,580	68,700,000	229 staffs x 10 days/time x 2 times (including accommodation and transportation fee)
Honorarium for fish farmers who provide place	5,000	36	180,000	3 days/time x 2 times x 6 sites
Transportation fee at training site	20,000	36	720,000	3 days/time x 2 times x 6 sites (including Per-diem/daily allowance for driver and fuel)
Preparation of documents	300,000	1	300,000	Copy for training materials set

Total 78,300,000

(6) Remarks based on the results of pilot project

- The curriculum should be prepared considering not only technological aspect but also necessary understandings and communication skills required for extension officer
- A collaboration system should be established between CeCPA/CeRPA and the DOF in order to follow-up activities of extension officer even after the trainings finish.

5.3.11 Project for establishment of aquaculture statistics system

(1) Background of the project

At present, there are no official systems to collect statistical data on inland aquaculture. When the M/P and A/P for development of inland aquaculture are implemented, relevant data collection and analysis will be required in order to monitor the progress and examine the project's impacts on time and feed them back to the next step. During the present M/P study, nationwide aquaculture census was undertaken in July 2008 as an initial attempt of data collection and analysis. Uniformed questionnaires were distributed for all the fishery extension officer and they were collected through CeRPAs. The data were encoded in the database software "Filemaker", and can be seen and retrieved at the Division of Inland Fishery and Aquaculture, the DOF. It is necessary to update the data periodically and establish a system for analyzing and reflecting the data in the policy making in the future.

(2) Objectives and Indicators

Short-term objective: Statistical data on aquaculture is managed properly in the DOF as well as CeRPAs.

Medium long term objective: Latest information can be obtained at any time whenever necessary

Indicators: Latest statistical data on aquaculture are referred in the documents prepared by the DOF.

(3) Outcomes to be expected

- Accurate field data are collected by fishery extension officer of CeCPA.
- The database of the DOF on aquaculture is updated.
- The officer of the DOF and CeRPA can analyze and process the data by using a simple matrix software.

(4) Activities

1) Target area: Whole country

2) Target group: Fishery extension officer and officer of the Inland Fishery and Aquaculture Division of the DOF

3) Major activities:

- ① Uniformed questionnaire is prepared by the DOF and methodology of data collection is determined.
- ② Fishery extension officers responsible for data collection are trained.
- ③ Training on how to use a simple matrix software EXCEL is carried out.

4) Project period: 6 months

(5) Inputs

1) One (1) expert on information technology (3MM)

2) The cost estimation is as follows;

Table 5-19. Cost estimation of the project for establishment of aquaculture statistics system

Activities	Items	Unit price	Quantity	Amount	Remarks
Training for extension staff	Honorarium for instructor	30,000	18	540,000	3 day x 6 sites (including accommodation)
	Per-diem/daily allowance for driver	10,000	18	180,000	3 day x 6 sites (including accommodation)
	Per-diem/daily allowance for extension staff	15,000	309	4,635,000	103 person x 3 days
	Print & copy expense etc.	100,000	1	100,000	Expense for photocopying
Training for excel	Honorarium for instructor	20,000	42	840,000	14 person x 3 days
Total				6,295,000	
*1) The target extension staff are of TSPH and CPH.					
*2) The target trainees on Excel training consist of 2 staff of Fishery Department and 2 staff of CeRPA, respectively.					

(6) Remarks based on the results of pilot project

No pilot project was implemented in relation to this project.

5.3.12 Project for aquaculture development in northern Benin

(1) Background of the project

In general aquaculture development potential is lower in the north, and only 66 fish farmers could be found in a total of the 5 northern districts at present. However, it shall be noted that there is a high demand for fish consumption and several fish farming groups continue aquaculture activities. Therefore, the northern Benin cannot be ignored from such aspect as comprehensive aquaculture development in rural areas. In early stage of the A/P, aquaculture activities will be activated and number of fish farmers as well as production will be increased in the southern Benin. Those experiences in the south will be able to apply for aquaculture development in the north so that local discrepancy shall be minimized. This project focuses on the northern 5 districts and stimulates the farmers' interest about aquaculture by increasing opportunities for farmers to get relevant technical information through periodical technical guidance and training on aquaculture. Accordingly it aims at improving productivity of existing fish farmers and also promoting participation of new fish farmers.

(2) Objectives and Indicators

Short-term objective: Number of fish farmer is increased in the northern Benin.

Medium and long term objective: Livelihood measures are diversified in villages of the northern Benin.

Indicators: Number of fish farmer increased

Improved productivity of existing fish farmer

(3) Outcomes to be expected

- Aquaculture extension activities are started in the northern districts.
- Productivity of existing fish farmer is increased.
- Farmers who are interested in aquaculture increase in number.

(4) Activities

1) Target area: 5 districts in the northern Benin (33 cities)

2) Target group: 66 existing fish farmers and about 500 candidate fish farmers who want to start aquaculture newly

3) Major activities:

- Extension officer of CeCPA conducts technical guidance trips in cooperation with the DOF.
- Technical trainings on aquaculture are implemented by leadership of CeCPA (*).
- New fish farmers are to be grown-out through input assistance such as provision of feeds and seeds
- A guide book on simple aquaculture is distributed.

(* Expected training facilities are those of Mr. Hilary, a progressive fish farmer, and/or NGO SONGAHAI Palakou, and the training period will be 2 weeks when the participants stay together in those places.)

4) Project period:

The project period will be 3 years starting from around the year 2015 after implementation of other action plans regarding development of quality broodstock of Tilapia, feed development, etc.

(5) Inputs

The cost estimation is as follows:

Table5-20 Cost estimation of the project for aquaculture development in northern Benin

Activities	Items	Unit price	Quantity	Amount	Remarks
Technical guidance	Per-diem/daily allowance for Staff of Fishery Dept.	28,000	108 person · day	3,024,000	3 days technical guidance, 12 times a year, total 3 years
	Per-diem/daily allowance for driver	10,000	108 person · day	1,080,000	accompanying the above work
	Extension staff of CeCPA incl. gasoline	5,000	360 person · day	1,800,000	5 days technical guidance monthly per 2 person, total 3 years
	Extension staff of CeCPA incl. gasoline	1,500	25,200 person · day	37,800,000	10 days technical guidance monthly per 70 person, total 3 years
	Fuel expense from Cotonue	150,000	36 times	5,400,000	12 times a year, total 3 years
Farmer training	Honorarium for instructors	30,000	108 person · day	3,240,000	14 days training, twice a year, total 3 years
	Expense for trainee (including meal accommodation, per-diem)	5,000	1,680 person · day	8,400,000	14 days training, twice a year, total 3 years, 20 person participation in each training
	Transportation fee for participants	5,000	120 person	600,000	2 times a year, total 3 years, 20 person participation in each training
	Printing, photocopying etc.	2,000	120 person	240,000	2 times a year, total 3 years, 20 person participation in each training
	Stationery (note, pen, marker etc.)	2,000	120 person	240,000	2 times a year, total 3 years, 20 person participation in each training
	Material for practice (net, rope, wire etc.)	5,000	120 person	600,000	2 times a year, total 3 years, 20 person participation in each training
	Equipment for practice (scale, bucket, basin, net	200,000	1 set	200,000	2 times a year, total 3 years, 20 person participation in each training
Support for participants	Seed	10,000	120 person	1,200,000	500 seeds are provided to 120 participants (unit price of seed is estimated 20 FCFA because beneficiaries bear half of the cost)
	Feed	200	21,600 kg	4,320,000	Necessary feed amount is estimated 180 kg each participant on the basis of following conditions. (the fishes grow 150 g with FCR 3, survival rate is supposed to be 80 % until harvest size) 180 kg of compound feed will be provided to 120 participants.
Visit and exchange amongst farmers	Gasoline	40,000	18 times	720,000	6 times a year, total 3 years
	Vehicle of CeRPA/CeCPA will be used Honorarium for farmers to visit	15,000	18 times	270,000	6 times a year, total 3 years
			Total	69,134,000	

(6) Remarks based on the results of pilot project

The target area is comparatively wide considering the number of beneficiaries. It is anticipated that information is reached only for the beneficiaries in certain areas, as far as conventional communication method is applied. In order to distribute information smoothly and equally among villagers it is recommended to utilize available mass media like radio when aquaculture trainings are implemented.

5.3.13 Project for development of fishery in artificial reservoir dams in northern Benin

(1) Background of the project

Many artificial reservoirs have been constructed in northern Benin in order to offer drinking water for cattle of nomads. However, few aquaculture or fishery activities have been seen in such water bodies. Under these situations, some fishing methods were introduced to a reservoir in a pilot project of this study, and as the result, it was verified that a kind of fish trap possessed a high dissemination potential because of its low cost for fabrication, easy maintenance, and simple handling. This project aims at activating reservoir fishing and diversifying rural livelihood through introduction of the fish trap.

(2) Objectives and Indicators

Short-term objective: Villagers living around reservoirs practice fishing.

Medium and long term objective: Livelihoods of villagers around reservoirs are diversified.

Indicators: Whether the villagers around reservoirs engage fishing or not / whether the same get fish catch or not (Quantity of fish catch is not focused.)

(3) Outcomes to be expected

- Fishing is conducted in reservoirs which have never been utilized for fishing.
- Livelihoods of villagers living around reservoirs are diversified by fishing activities.

(4) Activities

1) Target area: 5 districts in the northern Benin (Borgou, Alibori, Atacora, Donga, Collines), one (1) reservoir will be selected for every 33 cities of the 5 districts.

2) Target group: Villagers living around reservoirs who are members of reservoir management committee

3) Major activities

① Selection of target reservoirs

Reservoirs having relatively high development potential are selected among those enlisted in the 2008 census assisted by this study. Selection criteria are as follows;

- Located close to the village (short distance between reservoir and village, which causes no constraints in transportation of fish caught)
- Committee for reservoir management is organized.
- No fishing has been carried out (unused fishery resource is available.)

② Strengthening capability of the committee for reservoir management

The committee is instructed to be an organization for the villagers.

③ Implementation of training for fishing technology

Practical training is conducted regarding fishing gears, methods and technologies.

④ Assistance to fabrication of fishing gears (materials for making fish trap) and pirogues

Materials for making fish trap are provided and their fabrication was instructed by SPH. Pirogue will be provided.

4) Project period: 3 years

(5) Inputs

The cost estimation is as follows;

Table 5-21. Cost estimation of the project for development of fishery in artificial reservoirs in northern Benin

Activities	Items	Unit price	Quantity	Amount	Remarks
Support of fishing gears	Materials to make fishing trap (wire net, wire, nipper, pliers, rope, etc.)	200,000	33 groups	6,600,000	
	Pirogue	60,000	33 groups	1,980,000	
Training on fishing technology	Honorarium for instructors (including transportation)	15,000	132 person * day	1,980,000	4 days training at 33 sites in 3 years
	Meal allowance for participants	1,000	1,320 person * day	1,320,000	4 days training at 33 sites in 3 years, 10 participants in each training
Monitoring of fishing activity	Extension staff of CeCPA (including gasoline)	1,500	2,376 person * day	3,564,000	33 SPHs conduct 2 days monitoring every month. It will be continued 3 years
Total				15,444,000	

(6) Remarks based on the results of pilot project

- Number of fishing day and amount of fish catch should be recorded for fishery management.
- Post harvest rules (how to share fish catch among group members, etc) shall be discussed and decided earlier.
- It is necessary to establish the rule and regulation concerning the above before practical fishing operation is commenced.

5.3.14 Project for strengthening of fish farmers' group through capacity improvement of extension officer

(1) Background of the project

TSIECs, called « SOP » before 2006, are assigned in CeCPA as the officer responsible for community organization, but their training capacity would not be sufficient. On the other hand, rural people are accustomed to their guidance and recognized them as one of the leaders working closely in the village so that their effects on empowerment of villagers cannot be ignored. This project aims at improvement of TSIEC's capability for empowerment of villagers and implementation of trainings for strengthening people's organization at the same time. Through the project activities, capacity of TSIEC will be enhanced and fish farmers' group is strengthened. Although the project consists mainly of activities concerning strengthening fish farmers' group in principle, individual fish farmers will also be benefited somehow because subjects on strengthening individual management capacity are included.

(2) Objectives and Indicators

Short-term objective: Fish farmers obtain basic knowledge about people's organization.

Capability of extension officer on training villagers is improved.

Medium and long term objective: Capability of TSIEC about proper management of group activities is improved.

Indicators: Frequency of visiting villagers by extension officer is increased.

Indicators for evaluating group activities, i.e., frequency of activities, availability of tools and account book recording etc., are improved.

(3) Outcomes to be expected

- Capability of extension officer in the field of education for fish farmers is improved.
- Fish farmers participate in group activities positively, specifically proper management of organization.
- Fish farmers acquire basic functional literacy.
- Fish farmers understand management tools.
- Fish farmers utilize management tools properly and continuously.

(4) Activities

1) Target area: Whole country

2) Target group: TSIECs assigned at CeCPA of 77 cities

3) Major activities:

- ① Experts and CPs carry out training for RCPAs about educating people's organization as well as extension officer
- ② CPs carries out guidance for training instructors who will be trainers for extension officer.
- ③ Training instructors train extension officer about basic knowledge for operation and management of group as well as skills for educating villagers.
- ④ Extension officers carry out trainings for fish farmers about basic knowledge on proper management of group including observation tour of model village, utilization of visual teaching materials and so on.
- ⑤ Fish farmers use management tools periodically and continuously.
- ⑥ Fish farmers' group prepares relevant documents in accordance with the law, so that it is registered officially in the commune.
- ⑦ Instructors who conduct literacy training in rural areas are grown-out.
- ⑧ The trained instructors conduct literacy education to fish farmers.
- ⑨ Extension officer monitors fish farmers' group periodically.

4) Project period: 3 years

(5) Inputs

1) One (1) expert on strengthening people's organization (4MM x 3years)

2) The cost estimation is as follows;

Table 5-22. Cost estimation of the project for strengthening of people's organization through capacity improvement of extension officers

Activities	Items	Unit price	Quantity	Amount	Remarks
RCPA training	Per-diem/daily allowance	20,000	77	1,540,000	
	Transportation fee	20,000	77	1,540,000	
Guidance for training instructors	Honorarium for instructors	20,000	6	120,000	6 instructors are invited
	Teaching materials	30,000	1	30,000	expense for photocopying
Training for TSIEC (2 days training 4 times a year)	Honorarium (training)	70,000	48	3,360,000	held at 6 CeRPA, 8 days in total
	Honorarium (monitoring)	50,000	36	1,800,000	held at 6 CeRPA, 8 days in total
	Teaching materials	30,000	48	1,440,000	
	Per-diem/daily allowance for C/P	28,000	48	1,344,000	
	Per-diem/daily allowance for TSIEC	10,000	616	6,160,000	77 TSIECs participate in 8 days training
	Transportation fee for TSIEC	10,000	308	3,080,000	77 TSIECs participate in 4 days training
Training for residents (implemented by TSIEC)	Honorarium for instructors	3,000	1,540	4,620,000	20 trainings a year, 77 cities
Instructors training on literacy training (5 days)	Honorarium (training)	70,000	30	2,100,000	5 days, 6 sites
	Honorarium (monitoring)	50,000	30	1,500,000	5 days, 6 sites
	Teaching materials	8,000	30	240,000	5 days, 6 sites
	Per-diem/daily allowance for	28,000	12	336,000	2 days, 6 sites
	Per-diem/daily allowance for instructors of literacy education	10,000	385	3,850,000	5 days, 77 candidates of the instructors
	Transportation fee for instructors of literacy education	10,000	77	770,000	1 training, 77 candidates of the instructors
Functional literacy training for residents	Honorarium for instructors of literacy education	1,000	3,696	3,696,000	48 trainings a year, 77 cities
Total				37,526,000	

(6) Remarks based on the results of pilot project

- Since the extension officer's activities are affected by RCPA's capability and his/her degree of understandings, it is important to educate RCPA in terms of training.
- Extension officer shall be trained sufficiently because their basic knowledge and leadership affect largely and directly upon people's organization.
- Skill of extension officer shall be stabilized through practical trainings including exercises and practices because there would be big individual differences in their basic knowledge and leadership.
- Extension officer shall transfer their knowledge acquired by trainings to villagers properly.
- Transportation measures of extension officer to and fro villages shall be secured, since frequency of extension officer's visit affects largely people's organization.
- Training instructors are obliged to submit report and list of participants after respective training.
- In the training for villagers, management skills shall be established through numbers of exercises and practices considering participation of illiterate persons.
- Participants are required to submit report after observation tour for model villages.
- Existing group is to be strengthened and alternative new group is not recommended to build up.
- Extension officer shall grasp the situation of group management particularly on current monetary management and submit the written report to the project periodically.

5.3.15 Project for development of rabbit farming

(1) Background of the project

Rabbit farming has been popular in rural area recently aiming for meat production. This is because rabbit is easy to grow and breed with less cost for feed, and consumers accept its white meat comparing to the lean local chicken and imported frozen broiler provided under insufficient freezing infrastructure. Under such situation, PADPPA is grappling to extend rabbit farming as an alternative income source of fishers and has achieved the results to some extent. Thus, rabbit farming has contributed for diversification of income sources of villagers, and it is expected to be a subsidiary income source to provide relief fund among major economic activities of farmers such as agriculture and livestock.

(2) Objectives and Indicators

Short-term objective: Fish farmers who rear rabbits are increased.

Medium and long term objective: Sales of rabbits are used as relief fund for fish culture.

Indicators: Number of fish farmers who rear rabbits, and account book of fish farmers

(3) Outcomes to be expected

- Sales from rabbit farming are recorded.
- Cash flow of fish farming is improved.

(4) Activities

1) Target area: Whole country

2) Target group: 200 fish farmers in total (150 and 50 fish farmers in the south and the north regions, respectively, which are administrated respectively by 3 CeRPAs)

3) Major activities:

- ① Fish farmers who want to start rabbit farming are selected.
- ② Materials necessary for rabbit farming are procured.
- ③ Each CeRPA implements training on rabbit farming.
- ④ Necessary equipment is provided to trainees.

4) Project period: 2 years

(5) Inputs

The cost estimation is as follows;

Table 5-23. Cost estimation of the project for development of rabbit farming

Activities	Items	Unit price	Quantity	Amount	Remarks
Materials for rabbit culture	Female rabbit	2,500	800	2,000,000	200 farmers x 4 females
	Male rabbit	2,500	200	500,000	200 farmers x 1 male
	DMR seed	500	4,000	2,000,000	20 kg / farmer x 200 farmers
	Stilosantes seed	1,000	100	100,000	0.5 kg / farmer x 200 farmers
	Receptacle for drinking water	2,000	200	400,000	
	Feeding machine	2,000	200	400,000	
	Pelet for rabbit	140	18,000	2,520,000	50 g a day x 5 rabbits x 360 days x 200 farmers
	Scale	5,000	200	1,000,000	
Training for rearing technology	Honorarium for instructors	15,000	12	180,000	2 days x 6 sites
	Meal and transportation allowance for participants	2,000	400	800,000	2 days x 200 farmers
Total				9,900,000	

*1) DRM is a kind of improved com with abundant harvest

*2) Stilosantes is a kind of bean plants, which can be feed for rabbit.

(6) Remarks based on the results of pilot project

- Collaboration with SPA (animal husbandry extension officer) is indispensable.
- It is important to instruct farmers to place rabbit cabin near the residence since rabbit does not require wide space, and to care the animal carefully. Although rabbit is easy to rear, newly born babies are naked and weak against change of environment.

5.4 Implementing Method

5.4.1 Implementing system

Each project which is a component of the Action plan is managed and administrated by the project office to be established in the Department of Fisheries (DOF). The project office consists mainly of the Aquaculture Section, Inland Fishery and Aquaculture Division, DOF, and depending upon the necessity, other department such as the Department of Agriculture, the Department of Livestock and the Department of Planning and Coordination. The extension officer of CeRPA and CeCPA is assigned in the field, and the person who works closely with fish farmers will be the extension officer of each sector of CeCPA. The actual project activities are managed by them.

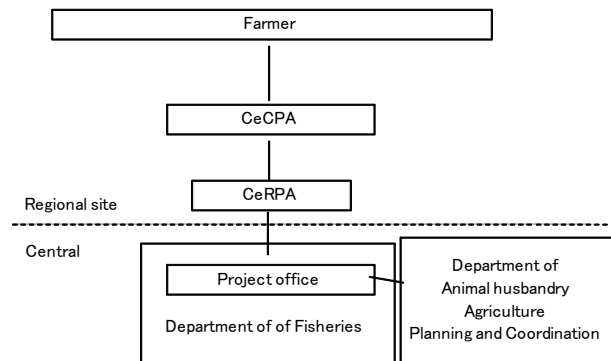


Figure 5-2. Diagram of Implementing system

5.4.2 Implementing period

Although more than 2,000 extension officer are employed and assigned in the CeRPA and CeCPA in 2007, only 3 technical officers are working in the Aquaculture Division, Inland Fishery and Aquaculture Division DOF, which will be a head office of the projects. It is not easy to manage the projects while doing regular operations and additional works occasionally commanded from the DOF headquarters. Therefore in order to avoid concentration of work loads on project management, the priority projects should be implemented earlier. In short, the capacity development type of projects which are considered fundamental and the technical development type of projects which take time will be carried out first. Taking the results into account, the technical extension type of projects are deployed mainly in the southern region. Lateral support type of projects are also implemented at the same time to strengthen the aquaculture management. Thereafter using the outcomes of bottoms-up of the aquaculture sector in the southern region, the project area are to be expanded to the northern region. The implementation period of each project is shown as follows. The implementing schedule of each project is shown in Figure 5-3.

The technical development type of projects and technical extension type of projects in the south, aims at establishing aquaculture mainly for middle scale fish farmers. And, lateral support type of projects and those which aim at developing aquaculture in the north support small scale (fish) farmers and farmers group having less capital but large in number. In the same manner, "Project for aquaculture extension through farmer-to-farmer training" targets at the initial stage, fish farmers whose activity is in suspension and middle scale farmers and gradually extends the target to small scale farmers who want to begin aquaculture. Thus more farmers will benefit the promotion of aquaculture.

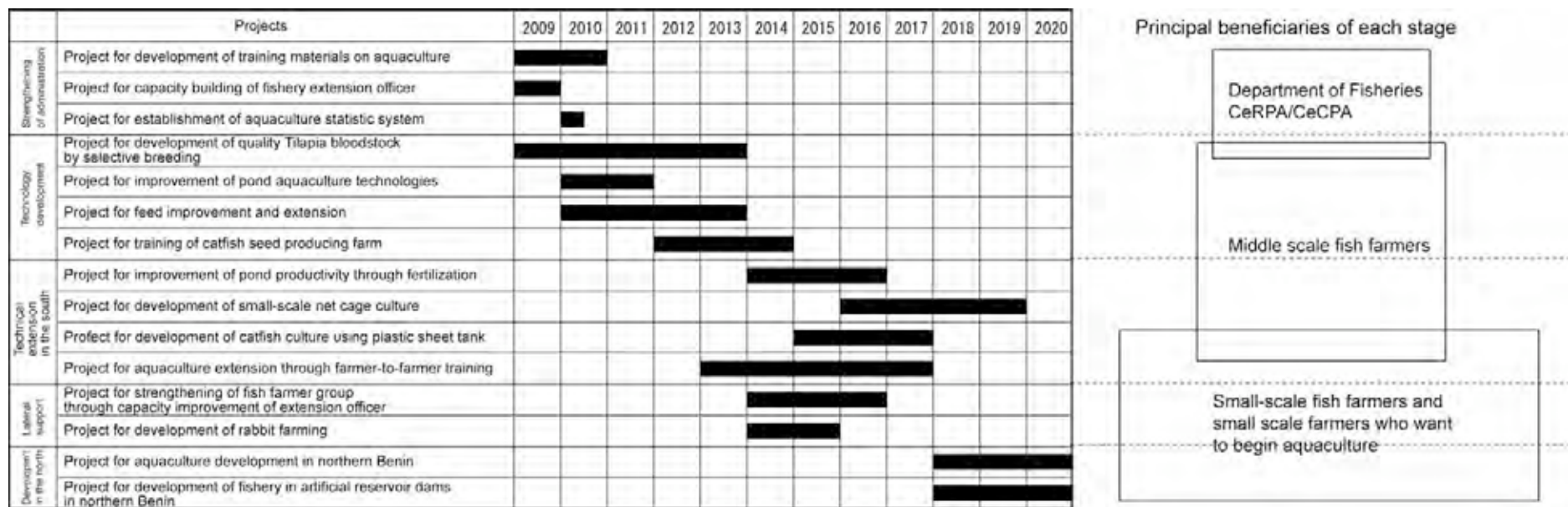


Figure 5-3. Overall implementing schedule and principle beneficiaries of each stage

5.4.3 Budgetary plan

Benin is a developing country with the GNI per capita of 510 USD (The World Bank 2005) and HDI of UNDP of 163 ranks out of 177 countries. Although country's budgets are not abundant, some projects are implemented by its own finance. In the fisheries sector, the "5 Years Fisheries and Aquaculture Development Plan 2007-2011" launched by the DOF allocates a total of 18,450 million FCFA, in which 10,260 million FCFA is for aquaculture development. Bearing in mind that the government distributes the limited budget to the priority fields, it should be considered to implement the A/P by their own finance in principle. The list of the proposed project cost in the A/P is as follows.

Table 5-24. List of the projects and estimated implementation cost

No.	Project Title	Cost (FCFA)
1)	Project for improvement of pond productivity through fertilization	49,504,000
2)	Project for development of small-scale net cage culture	31,500,000
3)	Project for development of catfish culture using small-scale plastic sheet tanks	72,700,000
4)	Project for development of quality Tilapia broodstock by selective breeding	20,470,000
5)	Project for improvement of pond aquaculture technologies	254,300,000
6)	Project for feed improvement and extension	35,430,000
7)	Project for training of catfish seed producing farmers	107,750,000
8)	Project for aquaculture extension through farmer-to-farmer training	1,091,542,800
9)	Project for development of training materials on aquaculture	9,515,000
10)	Project for capacity building of fishery extension officer	78,300,000
11)	Project for establishment of aquaculture statistics system	6,295,000
12)	Project for aquaculture development in northern Benin	69,134,000
13)	Project for development of fishery in artificial reservoir dams in northern Benin	15,444,000
14)	Project for strengthening of fish farmers' group through capacity improvement of extension staff	37,526,000
15)	Project for development of rabbit farming	9,900,000
	Total	1,889,310,800

Regarding the cooperation with other donors, there is a possibility to cooperate with African Development Bank (BAD), International Fund for Agricultural Development (FIDA) and Belgium Aid Agency (CTB) that finance for the fisheries sector. Besides, although FAO does not have their own finance source, they show a high level of interest in effective utilization of the artificial reservoir. They employ local consultants and carry out a survey about effective utilization of the artificial reservoir in the northern region. Exchanging opinions and information with the consultants has already been done. Then FAO may implement the action plan 13) 'Project for development of fishery in artificial reservoirs in northern Benin' or the project similar to the same. Moreover, FAO is now preparing a project on introducing improved broodstock of tilapia to 6 countries including Benin in the basin of the Volta River by getting fund from the Spanish government, then it is expected that the superior broodstock of Tilapia with its high growth performance will be introduced in the near future. This project is similar to the action plan 4) "Project for development of quality Tilapia broodstock by selective breeding", hence through the operation of this project, it is expected that the implementation period of whole A/P can be moved forward.

5.5 Environmental administration

The environmental issues are administrated by the Ministry of Environment and Natural Conservation. Regarding the environmental impact assessment (EIA), the Benin Environmental Agency (ABE) is

established as a specific authority responsible for the practical works under the Ministry. According to the Government Ordinance 2001-235 (on the EIA procedures), all the developers, no matter if they are public or private organs, should have an approval issued by the Ministry after necessary procedures instructed by ABE (Article 5 of the said Government Ordinance). However, there is an exceptional rule that the approval is not required for the following cases.

- Small-scale projects that don't affect fragile environment or don't discharge any waste.
- Projects of the natural resource development type without infrastructure development
- Projects against national crisis

For the approval of the Ministry, developers have to submit first of all the project document to ABE. In the course of document examination, if the project is evaluated as "no impact" to the environments, the approval is issued immediately. Otherwise ABE returns comments upon implementation of EIA. Then, the developers shall prepare the TOR of EIA according to the comments and submit it to ABE for approval. After the approval, the EIA shall be carried out for which necessary expenses be Covered by the developers or implementing organs.

There are two categories of assessment. One is simple assessment adopted for the projects of low risk, and the other is detail assessment for possibly high risk. The former is applied for small-scale projects to be implemented outside of the environmentally fragile areas. The latter is applied for large-scale projects or even for the small-scale project which will be implemented in the environmentally fragile areas. The so-called risk areas or environmentally fragile areas involve following topographical and geographical features.

- Wetland (river and its basin, flood plain, swamp)
- Crumbly mountain and hill slope
- Slope in upper river area
- Protection area
- Conservation area
- Holly place
- Thickly settled area, residential area in particular
- Surrounding of conservation facility
- Surrounding of military facility
- Habitat of endangered species

Aquaculture as an economic activity would not elaborate any negative impacts on the environment as far as the scale of activity is small. However, in cases that the scale becomes larger and aquaculture water is discharged to the environment, the some consideration shall be necessary. According to the aforementioned ordinance, simple assessment is obliged to aquaculture in principle. On the other hand, it is plausible that small-scale aquaculture to be implemented outside the fragile environment or not to discharge waste water will be exempted from the assessment. In fact there have been no cases that aquaculture development in rural areas are claimed for EIA from ABE.

There are four (4) Ramsar sites indicating ecologically important wetlands in the country (Fig. 5-4).

- National park “W”
Registered on February 2, 2007
Surface area: 895,480 ha
- Wet land along the Penjari River basin
Registered on February 2, 2007
Surface area: 144,774 ha
- Western complex that consists of
lower river basin of Couffo, Coastal lagoon,
Aho channel, Ahéme lake
Registered on January 24, 2000
Surface area: 47,500 ha
- Eastern complex that consists of lower river
basin of Ouémé, Porto-Novo lagoon,
Nokoué lake.
Registered on January 24, 2000
Surface area: 91,600 ha



Fig. 5-4. Ramsar sites in Benin

Most of the projects in the Action Plan that are proposed in the south will be implemented inside the two (2) Ramsar sites in which the National Capital Cotonou is located. Whereas, no projects are proposed in the northern two (2) Ramsar sites, since they are designated inside the wild life reserves.

The basic principle of the Ramsar Convention can be seen in the first paragraph of the Article 3 of the Convention, stating the importance on both “Conservation” and “Wise use” of wetlands. Wetlands relate closely with the human life and social activities so that the strict regulations like establishment of protected areas or off-limits areas at the uniform standard are not adequate as their conservation policy, and it is important to wise use of the wealth and function of wetlands. The Ramsar Convention is the international convention and the designated sites will receive international interests. However, new regulations and restrictions are not established upon the contract of the Convention, and only local laws and regulations can be adopted for the activities in the Ramsar sites in Benin as well as all the other contract parties. Shortly, at the planning of some development project in the Ramsar sites, it is necessary to remind “Conservation and wise use of the wetlands”, however no additional procedures for administrative permissions are required.

5.6 Preliminary environmental examinations on the proposed Action Plans

(1) Project for improvement of pond productivity through fertilization

Rating: C

This project aims at promoting aquaculture with fertilization by using excreta of pig, the method of which was proved effective in the pilot project of this study. Target group of the project will be existing pig farmers. The excreta discharged from piggery are once stocked in manure pit, agitated and then introduced to the pond. They are decomposed in the pond and function as organic fertilizer. Fishes mainly Tilapia grow with feeding on phytoplankton and zooplankton that propagated in the

fertilized pond. Thus this type of aquaculture can be recognized as a type of environmentally sound aquaculture. Although there have been no claim or damage regarding bad smell in rural pig farming, monitoring shall be done for the odor as increase of aquaculture activities.

(2) Project for development of small-scale net cage culture

Rating: B

This is the project for promoting simple net cage culture of Tilapia of which higher growth performance was verified in brackishwater. The brackishwater lakes or lagoons in the south (Nokoue Lake, Porto Nove Lagoon, etc) will be target areas. There is a concern about eutrophication of water environment caused by scattering of uneaten feeds in net cage culture.

In this project, the negative impact is minimized by strict guidance on feeding practice to fish farmers based on the lessons learned in the pilot project. Moreover, the sites of net cages are carefully determined not to disturb water transportation. As mentioned above, the target areas of this project include lakes and lagoons in the south designated as Ramsar sites. Therefore the project carries out periodical environmental monitoring in order not to over establishment of net cages considering the environmental carrying capacity.

(3) Project for development of catfish culture using plastic sheet tank

Rating: C

This project aims at promotion of small scale catfish culture in plastic sheet tanks that are practicable for those who don't have fish pond or land for pond construction. This type of aquaculture is really small in scale but becomes high density culture in stagnant water. In short volume of discharge water from the tanks is small in quantity, but at the time of water exchange more or less once a week, water containing relatively high BOD will be discharged. Although there is no site at present that the discharged water from tank causes any environmental problems, the project carries out monitoring about the state of activities particularly in the surrounding sites of urban area.

Because quality of plastic sheets would be deteriorated when they are used under natural condition for long-term though the actual situation may be different depending on the materials and environment, the treatment of the old sheets should be examined. Considering the custom of Beninese, the used plastic sheet will not be trashed but reused for other purposes such as roofing material. The project provides guidance about treatment of disused plastic sheet according to the regulation of Benin.

The beneficiaries of the project include those who don't have aquaculture ponds or land for pond construction. Through the pilot project, it was proved that with or without ownership of pond or land did not restrict the participation to this type of aquaculture. In addition, this project takes into account the participation of women. Judging from these aspects, no negative impact will be arisen for social environment.

(4) Project for development of quality Tilapia broodstock by selective breeding

Rating: C

This project aims at development of quality Tilapia broodstock through selective breeding among existing local Tilapia strains and their distribution throughout the country.

Since the selective breeding is conducted for local broodstock, no negative impact will be arisen for ecosystem. Also since the developed broodstock will be distributed to existing core fish farmers, which is scheduled from later half of the second year, serious and unexpected negative impact concerning soil and water environment do not occur.

(5) Project for improvement of pond aquaculture technologies

Rating: C

Improvement of the efficiency in pond culture is pursued in this project through provision and extension of small-scale aquaculture equipment. The equipments to be introduced include hapa net, scoop net, engine pump, seine net, etc. not including those affecting negatively the natural

environment. The guidance on environmental consideration is offered to extension officers of CeCPA who are in charge of distribution of those equipments. Upon the distribution of equipments, the sites are considered not to concentrate on certain communes and the beneficiaries bear a part of the cost. From these aspects, no social conflict must be occurred.

(6) Project for feed improvement and extension

Rating: C

This project aims at improvement of aquaculture productivity through development of artificial feeds using locally available and cheap agriculture by-products and livestock wastes

Since the project assumes to support preparation of homemade feed at farmer level, the quantity of feeds to be produced as a sample will be more or less several tons. Therefore, problems about discharged water or vibration of machine, which might be raised at large-scale feed plants, will not be anticipated. At the introduction and extension stage, adequate shape of feeds and feeding method will be instructed to farmers so as to reduce the amount of uneaten feeds. Throughout the project, the environmental load of aquaculture is expected to be reduced.

(7) Project for training of catfish seed producing farmers

Rating: C

This project aims at increase number of catfish seed producers through technical and financial assistance to existing fish farmers in order to meet high demand for catfish seeds.

Target group is existing fish farmers and the small-scale seed production method is to be taught. The environmental load of such seed production facilities is smaller than that in existing aquaculture facilities. Therefore, newly started seed production will hardly cause serious water pollution. For artificial manipulation of fish maturity, commercially available hormone will be administrated, which is non poisonous. Selection of target farmers will be done among the existing fish farmers having high intentions about seed production, so that mental inequality among candidates should be avoided.

(8) Project for aquaculture extension through farmer-to-farmer training

Rating: B

This project plans to grow-out core farmers who can act as the hubs in the extension of aquaculture technology in terms of “farmer-to-farmer” training. For concrete training programs and expected participants, refer to the Section 5.3.8 of this report.

Since this project proposes extension of aquaculture in the southern region where has been registered as Ramsar sites, the activities shall be followed with the policy of the Ramsar convention, namely “conservation of wetlands and their wise use”. First of all, the training program includes important environmental topics, such as environmental and hygienic management around the ponds, and environmental cautions during pond excavation, in the same way as the pilot project. Although the impact of discharge water to environment is considered negligible because technology to be extended is extensive or semi-intensive ones, the project provide continuously guidance on water quality of fish farms through seminars and distribution of educational materials.

There is no water quality standard for aquaculture in Benin. Just for the reference, the Japanese standard on water quality for aquaculture is shown below.

Table 5-25. Japan's water quality standard for aquaculture (2005)
(Extracted a part for fishes in temperate water like carp)

Water area	Rivers	Lakes
BOD	Less than 5mg/litre	-
COD	-	Less than 5mg/litre
Total phosphorus	Less than 0.1mg/litre	Less than 0.1mg/litre
Total nitrogen	Less than 1mg/litre	Less than 1mg/litre
DO	More than 6mg/litre	
pH	6.7 ~ 7.5	
	Inexistence of abrupt change of pH which make adverse effect to organism	
SS	Less than 25mg/litre (Less than 5mg/litre for SS artificial)	3.0mg/litre (transparency more than 1m)
Coloration	No disturbance of light passage for photosynthesis. No cause of escape.	
Temperature	Inexistence of abrupt change of temperature which make adverse effect on fishery related organisms	
Colon bacillus	Less than 1,000MPN/100ml	
Oil	No oil in water and now oil membrane found on surface	
Harmful matters	No agrichemicals, heavy metals, cyanogens, chemicals matters included	
Bottom	<ul style="list-style-type: none"> - No contamination with organic matters and no generation of germs - No fixation of minute SS on rock, gravel and sand which avoid the sedimentation and growth of seed. - Less than 10 times of the limit value concentration of harmful matters defined in water quality standard for aquaculture. 	

Source: Japan Fishery Resource Conservation Association (March 2006)

It can't be totally denied that habitats of wild animals may be influenced due to the development of aquaculture. There are still a lot of crocodile (*Crocodylus niloticus*) in Benin in swamp areas so that some countermeasures against the damages caused by crocodiles are now indispensable for fish farms. On the other hand, it is necessary to conserve as well its living environments since this crocodile is an endangered animals of the Red List of IUCN, although the risk of extinction is classified the lowest as "lower risk and lease concern". The DOF shall clarify exact location of the aquaculture project sites through the information from extension officers of CeCPA, exchange information with the Ministry of Environment and then takes necessary measures to control inadequate development, if any.

Regarding the selection of beneficiaries, the method of open recruitment will be employed considering specific characteristics of target communes, and the cost for seeds and feeds will be paid partly by beneficiaries. Therefore, there will be no negative social impact on rural community.

(9) Project for development of training materials on aquaculture

Rating: C

This is the project for developing materials to be used for aquaculture extension and training in accordance with important fish species and environments.

Target area is nationwide, and considering that the literacy rate of the people is as low as 45% (adult male, refer to this report 2.2.6), the project is to produce materials composed of flip charts and ample drawings as well as audio-visual materials.

(10) Project for capacity building of fishery extension officer

Rating: C

This is the project for strengthening the basic capability of fishery extension officers of CeCPA who are directly involved in extension activities regarding the guidance to farmers as well as aquaculture-related knowledge. The project activities consist of lectures and practical training in cooperative fish farms so that negative environmental impact is not expected.

In general farmers appreciate extension officers who work actually with them and advice them based

on the same vision. This project tries to address the extension officer to understand the vision of social unfortunates in rural community.

(11) Project for establishment of aquaculture statistics system

Rating: C

The major purpose of the project is to establish an aquaculture statistic system in order to enhance the precision of the statistics and to achieve periodical data collection and analysis in line with a preparatory work done in this study. The scope of the project is composed of training to fishery extension officers who act as data collectors, and guidance to fishery officers of the DOF on manipulation of computer software. No negative impact is expected on environment. However, since data collection work consumes a lot of papers, effort is needed to reduce the paper consumption by photocopy recto-verso.

(12) Project for aquaculture development in northern Benin

Rating: C

Following the aquaculture development in the southern region, this project will be implemented in the northern 5 prefectures where aquaculture is less developed so far, aiming at the improvement of productivity of existing fish farms and the encouragement of new farmer's participation mainly through on-farm technical guidance of extension officers.

Aquaculture technique to be promoted will be basically the same as in the south. Since the population density is low in the north, the project activity is geographically scattered accordingly. Therefore, serious impact on natural environment is hardly anticipated. On the other hand, since the target area is broad in area, it is considered to distribute information equally among the candidates at the time of holding training course.

(13) Project for development of fishery in artificial reservoir dams in northern Benin

Rating: C

Most of dam reservoirs in the northern region were constructed originally for drinking place of domestic animals. They have been suggested to have high potential of fishery and aquaculture development, but are not utilized well. This project aims at promotion of fishing activity using fish traps based on the result of pilot project, which proved that this type of fishing gear was effective under the circumstance that wild crocodile inhabit (namely few risk of accidental catch of crocodile unlike gill net) and easy to be operated by farmers. The dam reservoirs are usually managed by local management committee. This project involves organization of stakeholder meeting to avoid the conflicts regarding the distribution of benefit and monitoring of fish catch by extension officers of CeCPA in order to avoid over exploitation.

(14) Project for strengthening of fish farmers' group through capacity improvement of extension officer

Rating: C

This is a two-step approach project to strengthen the capacity of people's organizations (including individuals) in rural community through capacity building of extension officer in charge of people's organization (TSIEC) at CeCPA. It consists of training program and literacy education for target groups. No negative environmental impact is expected. As mentioned in "Fishery extension officers training project", attitude of extension officer to farmers is important. And it is also keen to pay attention not to have them unequal mind.

(15) Project for development of rabbit farming

Rating: C

This project promotes rabbit culture that can start with simple technique and small investment and can serve small operation fund of short term as a side business of aquaculture. Rabbits are grown in a small hut of several square meters with earthen floor or in a small cage that is just a size to accommodate a rabbit. Number of individual is at most 50 rabbits. There would be few problem about smell and fry since culture scale is not big. Transmissible diseases of rabbit are observed hardly. The

5.7 Evaluation of the Action Plan

5.7.1 Effect of production increase through implementation of Action Plan

Proposed projects in the Action Plan are classified in the following 3 different categories. The first one includes those contributing the increase of fish farmers and aquaculture facilities. The second one is those contributing the improvement of aquaculture productivity. And last one is comprised of those strengthening the capacity of fish farmers and related government institutions. Among them, the projects contributing directly to production increase are those in categories 1 and 2. The estimated aquaculture production derived from those of category 1 is shown in the table below.

Table 5-27. Estimated aquaculture production of newly recruited fish farmers and aquaculture facilities

No.	Project	Number of beneficiaries who contribute directly to the production growth	Fixation rate (%)	Revised number of active fish farmers	Unit scale of aquaculture facility	Surface or volume of aquaculture facilities	Annual production per unit surface or volume	Annual production (ton)
1)	Project for improvement of pond productivity through fertilization	270	90	243	800 m2	19 ha	6.8 ton/ha	132
2)	Project for development of small-scale net cage culture	100	70	70	20 m3	1,400 m3	7.2 kg/m3	10
3)	Project for development of catfish culture using small-scale plastic sheet tanks	1,000	80	800	1 tank		40 kg/tank	32
4)	Project for development of quality Tilapia broodstock by selective breeding							
5)	Project for improvement of pond aquaculture technologies							
6)	Project for feed improvement and extension							
7)	Project for training of catfish seed producing farmers				-			
8)	Project for aquaculture extension through farmer-to-farmer training (Tilapia)	2,900	50	1,450	600 m2	87 ha	4 ton/ha	348
	Project for aquaculture extension through farmer-to-farmer training (Clarias)	1,400	70	980	600 m2	59 ha	6 ton/ha	353
9)	Project for development of training materials on aquaculture							
10)	Project for capacity building of fishery extension officer							
11)	Project for establishment of aquaculture statistics system							
12)	Project for aquaculture development in northern Benin	500	20	100	600 m2	6 ha	4 ton/ha	24
13)	Project for development of fishery in artificial reservoir dams in northern Benin	33	70	23	-			
14)	Project for strengthening of fish farmers' group through capacity improvement of extension staff							
15)	Project for development of rabbit farming				-			
	TOTAL			3,643		171 ha		899

The projects 4), 5), 6) and 7) in the above table belong to the rating 2. Those listed as 9), 10), 11), 14) and 15) likewise belong to the rating 3. Those projects of 2 categories are not supposed to contribute directly to the production growth of new comers. Neither does the project 13) because it is not aquaculture but fishery.

According to the above table, the net growth of annual aquaculture production is estimated as 899 tons when all the projects in Action Plan are realized as scheduled. Newly participating fish farmers are 3,643 and net growth of ponds is 171ha.

Besides upon the implementation of projects that belong to the rating 2, the productivity of existing aquaculture facility is supposed to increase by 50%. Namely, the production per ha of present days will increase from 2.87tons/ha to 4.3tons/ha. By adding this portion, total aquaculture production is estimated as shown in table below.

Table 5-28. Estimation of fish farmers and production at target year of the Action Plan

	Number of fish farmers			Surface of pond (ha)	Production		Number of fish farming household	Calculation condition
	Individue	Group	Total		2008	2020		
Existing fish farmers (2008)								
North	27	27	54	7,2	20,6	30,8	243	Average productivity is improved from 2.87ton/ha to 4.3ton/ha
South	694	157	851	48,3	138,9	207,8	1 950	
Total	721	184	905	55,5	159,5	238,6	2 193	
New fish farmers (Note 2)								
North	50	50	100	6,0		24,0	450	
South	2 891	652	3 543	165,0		875,0	8 106	
Total	2 941	702	3 643	171,0		899,0	8 556	
Total fish farmers (2020)								
North	77	77	154	13,2		54,8	693	
South	3 585	809	4 394	213,3		1082,8	10 056	
Total	3 662	886	4 548	226,5		1137,6	10 749	

Note 1: Number of fish farming household was estimated as number of individuel farmers + number of group farmers x 8
 Note 2: Number of new fish farmers is esitimated with same proportion of current situation namely, 50% individue and 50% group in the north and 81.6% individuel and 18.4% group in the south.

The production of existing aquaculture facilities 238.6tons plus of new facilities 899tons is equal to total production 1,137.6tons at target year 2020 of the Action Plan. This amount corresponds to 7.1 times of the current production 159.6tons. It is really challenging plan but the production level is not enough at all to compensate the volume of imported frozen fish 46,466tons in 2006.

5.7.2 Effect of job creation in rural communities through implementation of Action Plan

According to the aquaculture census 2008, 2,193 fish-farming households were counted. Number of agriculture household was 566,071 in rural communities according to the RGPH3 of 2002. Although the year of data collection is not the same, if the number of agriculture household remains the same in 2008, the proportion of fish-farming household is only 0.39% in total agriculture household.

The fish-farming household is estimated to increase from 2,193 of today to 10,749 (4.9 times) at target year 2020 of the Action Plan. At that time, the proportion of fish-farming household increases to 1.12%. Net increase of fish-farming household is 8,556 and it is an effect of job creation in rural communities.

Table 5-29. Proportion of fish-farming household and total agriculture household

	Present situation (2008)			Future situation (2020)		
	Number of agriculture household	Number of fish farming household	Proportion (%)	Number of agriculture household	Number of fish farming household	Proportion (%)
North	264 331	243	0,09	450 006	693	0,15
South	301 740	1950	0,65	513 692	10 056	1,96
Total	566 071	2193	0,39	963 698	10 749	1,12

Note 1: Number of agriculture household increases in a groth rate of 3% per year.
 Note 2: Nomber of fish farming household includes all the houshold participating the aquaculture group.

5.7.3 Economic effect through implementation of Action Plan

(1) Macro-economic effect of Action Plan

The macro-economic value of the aquaculture sector is estimated as 195,500,000FCFA in 2008, judging from the fact that the value of fish is 1,000FCFA/kg, and increase in 1,137,600FCFA in 2020. The net growth is 978,100,000FCFA. On the other hand, the direct expenses necessary for the implementation of the Action Plan is 1,825,810,800FCFA (personnel cost not included). The total

project of cost is defined as “cost”, the net growth of aquaculture production as “benefit”, the IRR (Internal Rate of Return) in target 12 years is calculated as 33%. It is worth implementing the Action Plan.

Table 5-30. IRR of Action Plan

Year	Cost	Benefit	B-C
2009	150,151,500	0	-150,151,500
2010	270,404,000	0	-270,404,000
2011	440,160,060	140,160,000	-300,000,060
2012	355,518,727	280,320,000	-75,198,727
2013	396,435,393	420,480,000	24,044,607
2014	353,185,227	683,829,490	330,644,263
2015	334,909,893	878,720,157	543,810,263
2016	48,609,667	935,970,823	887,361,157
2017	32,108,333	949,157,490	917,049,157
2018	36,067,667	959,677,490	923,609,823
2019	36,067,667	970,197,490	934,129,823
2020	28,192,667	978,197,490	950,004,823
		IRR=	33%

(2) Micro-economic effect of Action Plan

The newly created economic value 978,100,000FCFA as a net growth of aquaculture production divided by the total number of fish-farming household is equal to net growth of annual income per household 90,994FCFA. With reference to the result of pilot project at Tori-Bossito that the average annual income of trainees of “farmer to farmer” training organized there, is approx. 300,000FCFA of which 200,000FCFA from Agriculture and 100,000FCFA from livestock farming, adding of annual income of approx. 90,000FCFA as a result of side business is meaningful in terms of improvement of income level and diversification of income source.

5.7.4 Contribution and ripple effect of Action Plan toward rural development and poverty reduction

(1) Benefit to labors

The majority of beneficiaries of the promotion of inland aquaculture through implementation of Action Plan are middle scale farmers having some capital. Those farmers usually recruit labors based on the experience of pilot project. It is expected that the employment opportunity of labors increases as business of farmers of this kind expands and salary of labors goes up as business income increases, through the promotion of aquaculture at farming household. Namely, the Action Plan contributes not only to owners of fish farm, but also to labors who work under the severe economic condition with those owners.

80% of 2,941 individual fish farmers indicated in Table 5-28 and that have a possibility to employ labors are supposed to do that. The concrete figure “80%” comes out from the study result of one of the pilot project sites called Tori-Bossito. Supposing that 80% of new individual fish farmers employ 1 labor, 2,353 employments (2,951 fish farmers x 80% x 1 labor) will be created. Based on the study at Tori-Bossito as well, because of the fact that the average number of permanent labor and of non-permanent labor is of 2.1 persons and 6.4 persons respectively (see Table 6-78), further labors will be recruited depending on the business scale and work volume during high season.

(2) Encouragement of flexible business finance in a household

In spite of the various business potential in rural area, lack of finance exists as a chronic problem. The microfinance charging 2% of interest per month is recognized to be effective for micro-business that money circle rapidly but not to be suitable for agriculture and livestock business that it takes long time to reCover the investment. The choice of farmers is to use income of a business to another and manage the business as a whole by the combination of some different businesses having different sales period.

The more farmers have business, the more possibility of combination increases. And the resistance to the unexpected situation will be higher. Through the implementation of Action Plan, the inland aquaculture may contribute as one of the business that supports the money management in a household.

An example is given for the case that the maize is planted in 1ha of farmland. In case of improved variety called "DMR" in general, 20kg of seed and 200kg (4 bags) of chemical fertilizer are input. Since the unit price of seed is 500 FCFA/kg and of chemical fertilizer is 13,000 FCFA/bag of 50kg, the necessary expenditure is calculated as 62,000 FCFA. If this amount of money is not assured by farmer and borrowed by some institute of microfinance, the interest of 6-month loan is of 4,960 FCFA (including grace period). For those who cannot assure 62,000 FCFA, the additional charge of 5,000 FCFA will be a burden for poor farmers. If a farmer culture fish as a secondary activity, this farmer is supposed to have an income of 90,000 FCFA (3 fish/m² x 200m² x 150g/fish x 1,000FCFA/kg) per 6 months per a fish pond of 200m². In the combination with aquaculture that is scheduled to sell fish and get income during the period that agriculture-relating expenses are expected, money management will be assured and business management will be stable.

(3) Improvement of business management capability

The basic capacity of fish farmers on business management will be improved through the participation to the capacity building type of project and production increase type of project. And if this improved capacity is applied to other activities, it may lead the increase of business income as a whole. At present, few farmers take note of the balance of business. Many farmers among the collaborators of pilot project cannot read and write. Besides, according to the socio-economic survey of 2007, 65% of farmers responded that they cannot read technical manuals (see page 3-38). For those who are very busy for every day life, it is practically difficult to study reading and writing during the spare time. But, they take part in the project and study in OJT, they may have chance practical literate education and finally a certain change that they begin to take note may happen. In addition, what they learn may lead not only to the improvement of capacity but also to the increase of chance to join further training course as well as to contact donors and NGOs.

(4) Improvement of fish consumption

Additional annual fish consumption per person is calculated from the aquaculture production growth of 1,137.6 tons (see Table 5-28) expected through the implementation of Action Plan, divided by the estimated population in 2020. Since the population is supposed to exceed 11 millions in 2020, the additional annual fish supply per person will be of 103g. FAO statistics shows that annual fish consumption per person is of 8.9kg in Benin. Consequently, the production growth contributes only 11% of total supply. In the inland area where marine fish is hardly supplied, the on-farm sales of aquaculture fish is appreciated in terms of freshness and quality. However, it does not mean that the Action Plan resolves totally the problem of fish supply in the inland areas.

(5) Rise of business chance for women and consistency between aquaculture and housework

Catfish culture with small scale and simple vinyl-sheet tank at home or aquaculture with ponds near house, can be compatible with housework, child care, gardening and animal husbandry because that sufficient time and work could be sacrificed to feed preparation and feeding and almost all the work is completed in and around the house. They don't have to go out, either to sell fish because fish is usually sold on farm. Comparing those who sell vegetables and daily commodities on the roadside all day long and earn little money, the hourly productivity is higher. And in general, women pay attention to the quality and sanitary condition of food. Self produced fish hardly have a sanitary problem, safe food life can be achieved. Because of this kind of circumstances, some women participated "farmer to farmer training course" of pilot project and attempted to start aquaculture. Some farsighted women in rural area may, in compatible with housework, conduct aquaculture to aide household economy and assure food safety from now on.

(6) Organization of fish farmers network

As number of fish farmers increases, fish farmers network will be organized and the exchange of

information and material to achieve mutual development in rural area will be enhanced. Actually, the trainees in the same class of “farmer to farmer” training course organized mutual aid type of group and got together periodically to exchange information in Tori-Bossito. This type of fish farmers network is expected to be formed in some different stages upon the needs. The most possible one is the network between core farmers who produce fingerlings and ordinary farmers. And as seen in south-east Asia, in the future, based upon the needs such as trade of fingerlings and feed among core farmers, and market information sharing, cross-functional network is expected. These network may be a strategic model of rural development in Benin.

The image of fish farmers network is shown in Fig. 5-5. Within the network, the trade of fingerlings, feed, aquaculture materials that leads directly to mutual benefit is enhanced and technical and market information will be shared as well. And the information exchanged is not only that of aquaculture but also a variety of information related to rural community life such as agriculture, livestock, education, social welfare. Within the network of core farmers, technically advanced information like fish disease and bloodstock culture is exchanged.

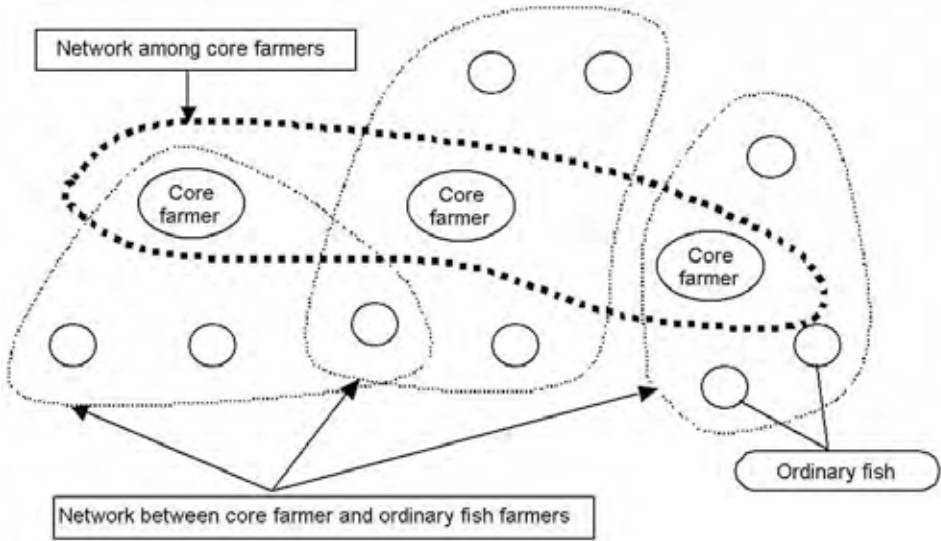


Fig. 5-5. Image of fish farmers network

Promotion of aquaculture of this kind brings benefit not only to farm owners but also to labors working at fish farm. Getting sufficient technique on aquaculture, those labors may have their own fish farming business in future. And, if additional core farmers are fostered from ordinary farmers, new network will be formed and lower income farmers have a chance to take part in aquaculture sector. Actually, for initial investment such as construction of pond and procurement of fingerlings, it may need further financial and technical support of the Government. However, small scale fish culture promoted by the Action Plan could be useful as an advanced case of aquaculture promotion to the poor.