

5. Implementation Schedule

5-1 Construction Schedule

The following items must be considered during the execution of the construction works.

- (1) The three sites are far apart from one another.
- (2) Civil engineering works occupy most of construction.
- (3) Consideration for the rainy season during construction.
- (4) Number of construction management staff (foreman, crew leaders, etc.) for the efficient construction.

5-1-1 Organization System of Construction Management

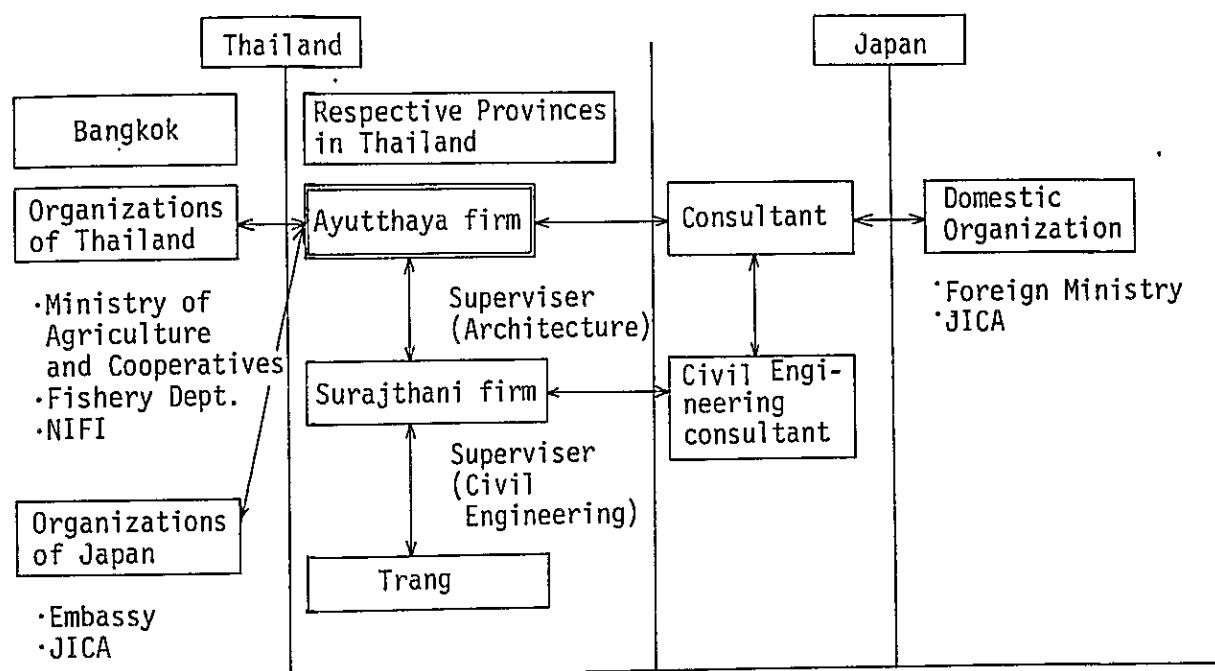


Fig 5-1 Organization System of Construction Management

The Office concerned with general control of project under construction shall be placed in Ayutthaya because it is the nearest site to Bangkok. Contact shall be kept with Surajthani, so that the works in Surajthani may be controlled and progress reported to the central organization in Bangkok and also to those concerned in Japan.

Depending on the conditions of the works, engineers will be despatched from Japan.

Both a building engineer and a civil engineer shall be stationed there and shall be controlled by contrived management and visits to the sites in turn.

5-1-2 Construction Management

(1) Construction Schedule

The construction will be started when the rainy season is over, but that time varies somewhat every year; sometime in January the construction is anticipated to begin. However, the work shall be started whenever it is possible. The term of total construction will be 13 months, and civil work should be finished almost before the start of next rainy season.

Materials and machines necessary for the works shall be ordered and the products inspected for transportation, so that they will be available in time to meet the start of work.

(2) Organization for Project Control

Field office and control organizations must be arranged to suit the sites in the three positions, the content of the works, and the character of each of the centers.

Ayutthaya:

- 1) General control of the three sites.
- 2) An experienced building engineer as site manager
- 3) Presentation of monthly reports to the appropriate organization
- 4) Request for the Japanese Engineer despatch
- 5) General on site inspection of center's construction in progress
- 6) Technical support from Japan

Surajthani:

- 1) Supervision (including Trang)
- 2) Experienced civil engineering engineer as manager
- 3) Project construction according to instruction from Ayutthaya
- 4) Assistance of civil engineering work in Ayutthaya as required.
- 5) Civil engineering inspection

5-2 Range of Construction Work

5-2-1. Outline of Work Division

(1) Work to be Completed by the Government of Thailand

All of the work necessary exterior the project site, construction of residential houses on the site, construction of a well water service system and main road.

(2) Work to be Completed by the Government of Japan

Equipment of fishery center

Installation of fisheries centers' equipment and facilities

Table 5-1 Division of Construction Labor for Each Country

Country Item	The Government of Thailand	The Government of Japan	Remarks
1. Cement Pond	No	Yes	
2. Earthen Pond	No	Yes	
3. Reservoir	No	Yes	
4. Center Bldg.	No	Yes	Ground Leveling for the buildings by the Government of Thailand
5. Hatchery	No	Yes	
6. Dormitory	No	Yes	
7. Main Road	Yes	—	Partly by the Govern- ment of Japan
8. Pump Station	No	Yes	
9. Dike	Yes	No	Construction Schedule should be confirmed
10. Residence	Yes	No	
11. Equipment	No	Yes	
12. Ground Leveling	Yes	—	Partly by the Gover- nment of Japan
13. Well	Yes	No	
14. Infrastructure	Yes	No	Construction schedule should be confirmed

5-3 Implementation Schedule

Table 5-2 Implementation Schedule

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
THE GOVERNMENT OF THAILAND	E/N	DESIGN CONTRACT	DESIGN CONTRACT	APPROVAL CONTRACT	APPROVAL CONTRACT	CONSTRUCTION CONTRACT	CONSTRUCTION CONTRACT														ACCEPTIVE
THE JAPANESE GOVERNMENT	E/N	VERIFICATION	VERIFICATION				VERIFICATION														
CONSULTANT		CONTRACT AND APPROVAL	CONTRACT AND APPROVAL	DESIGN																	
DETAILED DESIGN																					
BIDDING					TENDER ASSISTANCE																
SUPERVISION												SUPERVISION	SUPERVISION	SUPERVISION	SUPERVISION	SUPERVISION	SUPERVISION	SUPERVISION	SUPERVISION	SUPERVISION	INSPECTION
CONSTRUCTION COMPANY																					
EARTHEN CONSTRUCTION																					DERIVERLY
CONCRETE CONSTRUCTION																					DERIVERLY
BUILDINGS																					DERIVERLY
EQUIPMENT																					DERIVERLY

E/N; Exchange of Note

5-4 Maintenance and Operation Planning

5-4-1 Maintenance and Operation Capacity

Ability of the Staff

The Department of Fishery already possesses centers in several districts in the north, and also the NIFI which is the central research institute. Their ability and number of the staff is adequate trained for the maintenance and control of the project.

5-4-2 Management Plan

(1) Management Cost

1) Labor Cost

Data has been presented on personnel expenses by the Government of Thailand. The annual amount of personnel expenses is shown in Table 5-3.

Table 5-3 Labor Cost (Unit: 1000 Yen)

Center \ Year	1983	1984	1985	1986
AFC	12,600	21,000	24,150	26,250
SFC	15,750	26,250	28,350	31,500
TFC	4,200	10,500	18,900	21,000
Total	32,550	57,750	71,400	78,750

1) includes permanent staff and temporary help wages.

2) Running expenses

Expenses for electric power, gas, water, and generator are included in the running expenses as shown in Table 5-4. The running expenses will be paid from 1984 onward after completion of construction.

Table 5-4

(Unit: 1000 yen)

Center Item	AFC	SFC	TFC	Total
1. Electricity	3,460	4,350	1,120	8,930
2. Gas	793	793	39	1,625
3. Water	11	15	7	33
4. Generator	179	179	89	447
Total	4,443	5,337	1,255	11,035

Table 5-5 ~ 5-8 shows the details of the running expenses.

Table 5-5 Electricity

Center Item	AFC	SFC	TFC
Bldg. (kWh/Year)	129,723	156,300	34,700
Pumps for Ponds (kWh/Year)	18,150	29,449	13,118
Total Required (kWh/Year)	147,873	185,749	47,818
Unit amount (Yen/kWh)	23.4	23.4	23.4
Yearly Cost (Yen/Year)	¥3,460,000	¥4,350,000	¥1,120,000

Table 5-6 Gas (LPG)

Center Item	AFC	SFC	TFC
Daily Construction (kg/day)	25.17	25.17	1.25
Yearly Construction (kg/year)	7,551	7,551	375
Unit (Yen/kg)	105	105	105
Yearly Running Cost (Yen/Year)	793,000	793,000	39,000

Table 5-7 Well Water

Item \ Center	AFC	SFC	TFC
Daily Water Consumption (ℓ/day)	5,400	7,200	3,300
Yearly Water Consumption (Ton/Year)	1,620	2,160	990
Yearly Electricity Consumption (KWH/Year)	486	648	297
Unit (Yen/KWH)	23.4	23.4	23.4
Yearly Running Cost (Yen/Year)	11,000	15,000	7,000

Table 5-8 Generator

Item \ Center	AFC	SFC	TFC
Generator Capacity (KVA)	50	50	50
Fuel Consumption (ℓ/h)	14	14	7
Yearly Fuel Consumption (Total Hours/Year)	124	124	124
Yearly Fuel Consumption (ℓ/Year)	1,736	1,736	868
Unit (Yen/ℓ)	103	103	103
Yearly Running cost (Yen/year)	179,000	179,000	89,000

3) Maintenance and Operation Cost

The maintenance and operation cost of the buildings, roads, dikes and pump facilities is estimated at 1.5% of the construction cost. Maintenance and operation cost of the ponds is estimated at 5% of the construction cost.

Table 5-9 Maintenance and Operation Cost

(Unit: 1000 yen)

Item Center	Building, Road, Pump, Facilities		Pond		Total Maintenance & Operation Cost
	Construction Cost	Maintenance & Operation Cost	Construction Cost	Maintenance & Operation Cost	
AFC	267,600	4,014	105,700	5,255	9,299
SFC	446,200	6,693	103,200	5,160	11,853
TFC	129,700	1,946	50,800	2,540	4,486
Total	843,500	12,653	259,700	12,985	25,638

4) Miscellaneous Expenses

Miscellaneous expenses include the operation cost of transportation, feed, etc, which will be needed after the end of construction in 1983. The number were received from the Government of Thailand

Table 5-10 Miscellaneous Expenses

(Unit: 1000 yen)

Year Center	1983	1984	1985	1986
AFC	8,400	10,500	12,600	15,750
SFC	8,400	10,500	12,600	15,750
TFC	4,200	7,350	9,450	11,550
Total	21,000	28,350	34,650	43,050

(2) Thailand Budget

Table 5-12 shows the yearly budget for this project. The numbers are received from the Government of Thailand.

Table 5-11 Budget for MODC, DOF and IFD

(Unit: U.S.\$MIL.)

Organization Year	MOAC	DOF	IFD
1978	350	9.5	1.6
1979	380	10	2
1980	420	12	2.1
1981	620	15	2.5
1982	650	17	6

Table 5-12 Proposed Budget for the Three Centers

(Unit:U.S.\$MIL.)

Year \ Center	AFC	SFC	TFC
1982 1)	0.50	0.50	0.25
1983 1)	0.60	0.65	0.30
1984	0.30	0.35	0.15
1985	0.40	0.45	0.25
1986	0.50	0.55	0.30
Total	2.3	2.5	1.25

1) Construction Period

6. Project Evaluation

6-1 Social and Economic Effects

Socio-economical effect of the present project is enumerated as general effect as follows in the region of the subject areas.

- * Increased production of fresh water fish
- * Improvement of the technology for culture of fresh water fish
- * Increased fish consumption by the farmers and fishermen (as animal protein source)
- * Increased income of the farmers and fishermen
- * Increased employment opportunities
- * Acquiring foreign currency, although it is small portion.⁻¹

⁻¹ *Oxyeleotris marmoratus* to be produced in Ayutthaya Fishery Center as seed fish are cultured mainly for export at a high price.

6-1-1 Evaluation of Training Program

Training Program is conducted with accommodations of the trainees in the dormitories in Ayutthaya and Surajthani Fishery Centers. The program includes the lecture and practical exercise. Trainees will take the courses, as shown in Table 4-4, which include training for 3-15 days as a group of 25 on courses of general fish culture, intensive culture by the species of fish, propagation by the species, culture feed and feeding, fish disease, and fishing management (breeding in Ayutthaya in addition).

The number of trainees will be in the rate of 1 national government officer (related to fishery), 2 local government officers (related to fishery), 2 related public servants, and 10 local farmers and fishermen. The total number of trainees after 1985 will be 375 in Ayutthaya, including 250 farmers and fishermen, and 300 in Surajthani, including 200 farmers and fishermen, every year. The trainees are expected to convey the technique acquired to their family members and neighbors with due propagation effect.

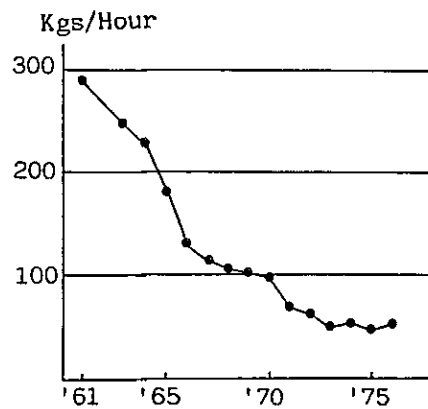
Training and diffusion through practice is indispensable in the case of fish culture. Trainees shall be selected from among those farmers and fishermen who will probably engage in raising fish based on their acquisition during the training (management of fish culture, management of pond for domestic consumption). Assistance by the government to them

after training, such as convenience in using the land for the pond, etc., is hoped for the further growth of the inland fisheries.

Training could generate an increase in the chances of employment, in the income, and enhancement of inland fishery technology.

6-1-2 Analysis of Employment Situation

As already explained as regards the background, no bright future can be expected at present of the ocean fishery in Thailand due to the decline in bottom fish resources in the Gulf of Thailand, the high price of fuel, and due to 200-mile exclusive economic zone. (See Fig.6-1). Approximately, a half of the trawling boats are suspending their operation. The average number of crew is 20 and about a half of them come from the South. (Operation Center, Inland Fishery Division, Department of Fishery, Ministry of Agriculture and Co-operative)



Quated: "Plamon 2" The Investigation Conducted by the Department of Fishery, Thailand.

Fig. 6-1 The Trawling Fish Capture Rate in the Gulf of Thailand

Table 6-1 Trawling Boats and the Amount of the Captured Fish

Year	The number of Boats	The Captured Fish (ton)
1960	99	63,711
1961	201	123,077
1962	976	151,403
1963	2,026	227,650
1964	2,360	371,642
1965	2,393	392,666
1966	2,695	430,703
1967	3,077	645,249
1968	3,182	743,746
1969	3,185	907,850
1970	3,114	961,395
1971	3,338	1,140,194
1972	4,486	1,017,283
1973	5,837	1,124,098
1974	5,271	998,193
1975	4,962	930,566
1976	5,204	882,183

Quated: Fisheries Record of Thailand

The number of jobless fishermen for trawling boats is calculated from the number of trawling boats in 1976 at 5,204 (Table 6-6), the number of crew at 20 per boat, and a half of the boats suspending operation, give 52,000 persons, a half of whom coming from the South. The number is divided to Surajthani and Trang Region. Base on the proportion to the total population, unem ployed persons are estimated 11,000 in Surajthani Region and 6,000 in Trang Region, due to the decline of trawling fishery. This project will have a possitive effect on increasing the employment opportunities.

6-1-3 Evaluation of Extension Service

Extension Service means the activity by the staff of the centers for guidance of farmers and fishermen on propagation and culture of inland fish through mass media (television, radio and newspaper); and the number of days in a month for the activity by the staff of the center, including the chief of the center, is presented. (See Table 4-6)

Basically, extension service is conducted by officers going out to the regions of need in coping with the problem of fish culture as against training program being carried out in the center by collecting the trainees.

Fish culture is comparatively active in a part of Ayutthaya Region but in Surajthani and Trang Regions, the activity is quite poor; and importance of promotion is understood.

It is understood that the poor activity in the South, including Surajthani and Trang Regions, with small number of inland fishery centers, was caused by the poor activity in promotion. On the other hand, the recent elevation of desire for inland fishery is triggered by introduction of the actual technology and management through film which is revealed by Inland Fishery Development and Operation Center, Inland Fishery Division, the Department of Fishery.

6-2 Evaluation of Seed Fish Production

6-2-1 Distribution System

According to the information obtained from Inland Fishery Development and Operation Center, Inland Fishery Division, the Department of Fishery, the seed fish is distributed as follows:

- (1) In the public rivers, lakes, and ponds, seed fish is released free of charge, so that they grow under the natural conditions and anyone of the inhabitants can catch without burdens of expenses.
- (2) For the public ponds of villages, seed fish is distributed free of charge where the fish are protected from theft until they grow up, with occasional feeding with available cow dung and others. After 8 to 10 months from the release of seed fish, the villagers can catch the fish freely with cast net, etc. by paying 30 ¢ of fishing charge a day. They can either consume the fish at home or sell. The charge collected is appropriated for the public activities such as school through the public organization.
- (3) Seed fish is distributed to poor individuals who want to raise them in nearby pond, paddy field and personal reservoir, for their domestic consumption, without charge. Seed fish are sold to those who can pay. The produced adults fish belong to the individuals.

(4) Seed fish is sold to those who run aquaculture business.

6-2-2 Evaluation of Fish Culture System

The systems of raising the seed fish to edible size can roughly be classified into the following 4 classes.

- (1) Natural water discharge system: seed fish is released into natural waters (river, lake, reservoir, pond, etc.) with practically no maintenance.
- (2) Extensive culture: seed fish is discharged into enclosed ponds, paddies, and ditches, but practically no manure or supplementary feeds are given.
- (3) Semi-intensive culture: the seed fish is discharged into enclosed culture ponds, irrigation ponds, paddies and ditches. Manure and supplementary feeds are given to some extent.
- (4) Intensive culture: The seed fish is released into culture ponds, and cage. At a high density of the seed fish, a sufficient amount of manure and supplementary feeds should be supplied.

The amount of production from the same amount of seeds increases, generally speaking, under controlled conditions, with an increase of supply feeds. The seed fish produced by the present project should preferably be raised under controlled conditions, although the aptitude for such controlled system differs depending on the kind of fish as subject.

Table 6-2

Production Increase →

Labor and Feed Increase ↓	Production System	Natural Water Culture	Extensive Culture	Semi-intensive Culture	Intensive Culture
	Item				
	Survival Rate	Little Reliable Data	Relatively High	High	High
	Operation (Water Quality, Grasses, etc.)	No	Carely	Sometime	Often
	Feed (Grasses, Cattle Wastes In Organic Manure, etc.)	No	Seldomly	Sometime	Sometime
	Support Feed (Pellet, Trash Fish, Rice-Bran, Bronken Rice, etc.)	No	No	Rarely	Daily or Periodically

The economy of production system is shown schematically in table 6-2 which reveals that personnel expense and feed expense are necessary in order to increase the production, and economical evaluation is called for. Also, the expenses and labor for catching must be added to the above in any of the cases.

As shown in Table 6-3, production systems for fish breeding, herbivorous and omnivorous fish are suitable for raising under conditions utilizing the natural productivity up to the semi-intensive culture, and can provide farmers and fishermen with animal protein and a source of additional income. Carnivorous fish would be suitable for culture on commercial basis. Especially, *Oxyeleotris marmoratus* is of high price, mostly being exported to Hong Kong, Taiwan, etc., and can be a subject for acquiring foreign currency.

Therefore, in the regions such as Surajthani and Trang where propagation and culture of fish are going to be promoted from now on, it is an appropriate selection that herbivorous and omnivorous fish are chosen as subjects, while some carnivorous fish are added to the target of production in Ayutthaya region where culture technology comparatively advanced is.

Table 6-3 Production Systems for Fish Breeding

Item Fish Name	Feeding Habit	Production Method			
		Natural Water Culture	Extensive Culture	Semi-intensive Culture	Intensive Culture
1. <i>Trichogaster pectoralis</i>	Herbivore Omnivore (Plankton-Feeder)	○	○	○	
2. <i>Puntius gonionotus</i>	Omnivore (Plankton-Feeder)	○	○	○	
3. <i>Tilapia nilotica</i>	Omnivore (Plankton-Feeder)	○	○	○	○
4. <i>Cyprinus carpio</i>	Omnivore	○	○	○	○
5. <i>Pangasius sutchi</i>	Omnivore (Carnivore)	○	○	○	○
6. <i>Oxyeleotris marmoratus</i>	Carnivore				○
7. <i>Channa striatus</i>	Carnivore		○	○	○
8. <i>Clarias batrachus</i>	Omnivore (~Carnivore)		○	○	○
9. <i>Labeo rohita</i>	Omnivore	○	○	○	

○ .. Desirable System

6-2-3 Analysis of available Water Areas for Fish Production

While rivers, lakes, reservoirs, and others are utilized as water for raising the seed fish produced, data were available only for a part of them for the registered public water areas. (data given by Operation Center, Inland Fishery Division, Department of Fishery, Ministry of Agriculture and Co-operation.)

Table 6-4

Item . Provinces	Registered Water Area (ha)	Seed Fish Pro- duction by this Project (mil.)	Fish Density in the Regis- tered Water Area (/m ²)	Production Area (ha)
Ayutthaya Province and 4 other Provinces	1,378	60	4.3	14,715
Surajthani Province and 4 other Provinces	1,610	120	7.5	19
Trang Province and 4 other Provinces	3,559	30	0.8	107

According to the data, even in the case of discharging the seed fish in the registered water areas, the number of fish in 1 m² of the water is less than 10; and the space for raising the seed fish would be sufficient if other unregistered areas, rivers, culture ponds, etc., are taken into consideration.

In consideration of the quality of water, all of the subject fish species in Atutthaya Fishery Center are living in the natural waters of the region (explanation by the fishery officer in Trang province), beside culture of Rohu not being technically difficult; and the space for raising was judged sufficient also from the point of view of fish species.

It is noticeable from Table 6-4 that the area for culture in Surajthani and Trang Regions is of a trifling amount as compared with that of Ayutthaya Regions; therefore, this project plays an important role.

Therefore this project plays an important role.

6-3 Demand and Supply

6-3-1 Analysis of Demand

(1) Population

Future population in 1990 and 2000 was anticipated for the whole country, and central, northeastern, northern, and southern districts respectively based on the increasing rate in 1970, 1975, and 1977 through 1980 (by Department of Local Administration, Ministry of Interior,); and the result was corrected so as to agree with the anticipated values by the Government of Thailand for 1990 and 2000. The result is shown in Table 6-5.

Similar estimation was made for Ayutthaya Region (5 provinces including Ayutthaya Province), Surajthani Region (5 Provinces including Surajthani Provinces) and Trang Region (5 Provinces including Trang Provinces); and the result obtained is shown in Table 6-6.

Table 6-5 The Regional Population in the Kingdom of Thailand
(Including Future Projection)

(Unit: 1,000 persons)

Region \ Year	1970	1975	1977	1978	1979	1980	1990	2000
Central	10,612	13,719	14,466	14,788	15,112	15,463	20,603	25,703
North-Eastern	12,025	14,534	15,148	15,494	15,793	16,088	20,368	24,676
Northern	7,489	8,913	9,202	9,353	9,493	9,588	11,884	14,139
Southern	4,271	5,226	5,457	5,586	5,716	5,823	7,455	9,096
Total	34,397	42,391	44,273	45,222	46,114	46,961	*63,529 60,310 56,742	82,828 73,614 65,413

Quoted: Department of Local Administration, Ministry of Interior

* Population Projections for Thailand, by Different Assumptions
National Economic and Social Development Board.
Institute of Population Studies, Chulalongkorn University
National Statistical Office (max.med.min.)

The population in 1990 and 2000 are projected on the basis
of the past data and Thailand Projection.

Table 6-6 Population of the Three Provinces
(Including Future Projections)

(Unit: 10 (Unit: 1,000 persons))

Region	Year Province	1970	1975	1977	1978	1979	1980	1982	1990	2000
Central Region	Ayutthaya Province	4,142	5,682	6,120	6,283	6,447	6,635	7,163	9,275	11,892
	Others	6,470	8,037	8,346	8,505	8,665	8,828	9,531	11,329	13,812
	Total	10,612	13,719	14,466	14,788	15,112	15,463	16,694	20,603	25,703
Southern Region	Surajthani Province	1,796	2,252	2,298	2,347	2,394	2,441	2,577	3,123	3,795
	Trang Province	998	1,190	1,260	1,297	1,327	1,354	1,430	1,732	2,114
	Others	1,477	1,784	1,813	1,942	1,995	2,028	2,140	2,599	3,187
	Total	4,271	5,226	5,457	5,586	5,716	5,823	6,147	7,455	9,096

Department of Local Administration, Ministry of Interior.

Quoted: Population Statistics up to 1980

(2) Present and Future Consumption of Fish in Subject Regions

The amount of consumption of fish in the three subject regions in 1990 and 2000 as estimated from the population, increasing rate of income, and modulus of elasticity of fish consumption by income is as shown in Table 6-7.

Table 6-7

Region	Provinces	Co (Fish Consumption in 1982)(kg/persons year)	g (The Growth Rate of GRP) (%)	Pt(The population at the year t (10 ⁵))		Ct(The Fish Consumption at the year t (kg/persons year))		Dt(Total Fish Consumption per year (ton))	
				1,990	2,000	1,990	2,000	1,990	2,000
Central	Ayutthaya province and 4 other provinces	25	7.1	9,275	11,892	29.3	35.6	271,423	423,719
Southern	Surajthani province and 4 other provinces	20	3.0	3,123	3,795	21.4	23.2	66,783	88,233
	Trang province and 4 other provinces	20	3.0	1,732	2,114	21.4	23.2	37,037	49,150

Dt: Total fish consumption/demand in the year t for the subject district in ton

Co: Annual consumption/demand of fish per person in the base year (1982) in kg/person.year.

Ct: Annual consumption/demand of fish per person in the base in the year t, in kg/person year

g: The Growth rate of GRP

Average value of 7.1% is adopted for g for the central district where the situation is stable, while the newest value of 3.0% is adopted for the southern district where the situation is unstable.

e: Modulus of elasticity of fish consumption by income, 0.28 was used.

(from: Department of Fisheries, 1976: National Plan for Agriculture Development in Thailand)

The result was tabulated along with the consumption/demand in 1982 as follows:

Table 6-8 Fish Consumption Projection in Respective Regions

Province \ Year	1982	1990	2000
Ayutthaya Province and 4 other Provinces	179,075	271,423	423,719
Surajthani Province and 4 other Province	51,540	66,783	88,233
Trang Province and 4 other Provinces	28,600	37,037	49,150

It is noticeable that the fish consumption is very high in Ayutthaya Region where the population is large and that the increasing rate 52% in Ayutthaya Region and 30% in Surajthani and Trang Region are expected for 8 years from 1982 to 1990. Furthermore, an increase of 56% in Ayuttuy Region and 32% in Surajthani Region is expected for 10 years from 1990 through 2,000.

On the other hand, Davy & Wilson (1971) studied from the medical aspects and concluded that "People in the tropical countries need for their health intake of at least 1 g/kg body weight of protein every day", and calculated the amount of fish consumption for the health of people of Thailand based on their diet at 46.8 kg/person. year. (From: USAID, 1981: Report from Village Pond Project)

A necessary amount of fish consumption for the subject Regions was calculated from the conclusion of previous study and the population in Table 6-6 as shown in the following table.

As shown in Table 6-9 production is larger in number than the fish consumption project Table 6-8.

Table 6-9 Required Amount of Fish Production

Province \ Year	1982	1990	2000
Ayutthaya Province and 4 other Provinces	335,228	434,070	556,546
Surajthani Province and 4 other Provinces	241,207	146,156	177,606
Trang Province and 4 other Provinces	66,924	81,058	98,935

6-3-2 Fish Production Statistics

According to the explanation by Operation Center, Inland Fishery Division, Department of Fishery, Ministry of Agriculture and Co-operative, to the investigation mission, survival rate expected from the seed fish to harvest is 50% and the weight of 10 harvested fish is 1 kg. However, the survival rate of fish, under circumstances including natural to intensive culture states, ranges from 0 to 100% strictly speaking. Yasuhiko Taki, Assistant Professor of Tokyo Fishery University at present obtained the following survival rate in carps in Noing Teng Fish Farm in Vientian, Laos, as a result of crude stocking.

Table 6-10

Pond Number	Size of Pond (ha)	Size of Carp Seed (cm)	Stocked Date	Harvested Date	Stocked Number	Survival Rate (%)
1	1	5~6	1970.5	1970.11	1,560	45.1
2	1	5~6	1970.5	1970.11	22,600	5.1
		2	1972.4	1973.5	8,000	8.5
3	1	2	1966.6	1967.7	20,000	3.0
		5~6	1972.6	1973.5	5,500	15.5
4	1	2	1966.6	1967.5	20,000	7.2
		5~6	1967.6	1968.3	3,600	18.8
		5~6	1972.6	1973.4	9,000	9.3
5	1	2	1966.6	1968.3	20,000	0.3
		5~6	1972.3	1973.3	6,000	22.1

Although the result of survival rate shows a large dispersion, it is understood that the lower the survival rate is and the longer the period of cultures and the smaller the seed fish.

In the project, a large part of seed fish are of 3 - 5 cm size fish, and the farm for stocking varies from natural water to culture pond; and it is difficult to obtain an average for the survival rate, but we adopt the figure of 15% from discharge to harvest.

As for the weight of harvested fish, the figure by the Thailand Government is regarded appropriate, for all of the kinds of fish grow to 100 g min. weight within 6 - 10 months after discharge, and 1 kg per 10 fish harvested was adopted. Thus the estimated amount of

production is

Ayutthaya Region	:	900 ton/year
Surajthani Region	:	1,800 ton/year
Trang Region	:	450 ton/year

6-3-3 Production Amount Per Person

The amount of estimated production per person in each region against the direct contribution is as follows:

Table 6-11 (Unit:kg/person-year)

Province	Year	
	1990	2000
Ayutthaya Province and 4 other Provinces	0.10	0.08
Surajthani Province and 4 other Provinces	0.58	0.47
Trang Province and 4 other Provinces	0.26	0.21

6-3-4 Comparison between Production and Demand

The amount of fish demand (as anticipated from the income), production of fresh water fish, and the production by the present project in each of the subject regions are shown in Table 6-12 for comparison.

table 6-12 (Unit: Ton)

Province	Item	Year	
		1990	2000
Ayutthaya Province and 4 Other Provinces	Required Amount	271,423	423,719
	Fresh Water Fish Production	83,096	130,687
	Fish Production by this Project	900	900
Surajthani Province and 4 Other Provinces	Required Amount	66,783	88,233
	Fresh Water Fish Production	9,254	14,069
	Fish Production by this Project	1,800	1,800
Trang Province and 4 Other Provinces	Required Amount	37,037	49,150
	Fresh Water Fish Production	4,102	6,419
	Fish Production by this Project	450	450

It is noticeable from Table 6-12 that the production of fresh water fish is small in comparison with the demand, and the production by the present project can satisfy a part of the shortage. Besides, the rate of direct contribution of the present project is not very large by what is expressed in figures; but spreading effect by the training and promotion can be expected beyond the figures.

6-3-5 Fish Production Capacity for Farmers and Fishermen

No accurate data were available as regards the number in the subject provinces of farmers and fishermen related to the project.

According to the investigation by hearing (answered by the prefectural officer during interview with the provincial governor) the number farmers and fishermen was about 10,000. In Trang province, the initial number of those expected to be related with the inland fishery of the present project was estimated at 5,000 (5 x 1,000 families) (by Mr. Pacherin Somsopon, Trang Provincial Fishery Officer).

The number of farmers and fishermen related to the project was calculated from the data and in proportion to the population as follows:

Table 6-13 Population (Unit: 1,000 persons)

Province \ Year	1980	1982	1985	1990	2000
Ayutthaya Province and 4 other Provinces (Ayutthaya Province)	6,635 (623)	7,163 (673)	7,955 (747)	9,275 (871)	11,892 (1,117)
Surajthani Province and 4 other Provinces (Trang Province)	2,441 (427)	2,577 (451)	2,782 (487)	3,123 (546)	3,795 (663)
Trang Province and 4 other Provinces (Trang Province)	1,345 (427)	1,430 (451)	1,543 (487)	1,732 (546)	2,114 (667)

Base on the number of target farmers and fishermen are 10,000 in Ayutthaya and 5,000 in Surajthani and Trang, the numbers of farmers and fishermen in each 5 provinces were estimated as in Table 6-14.

Table 6-14 The Population of Target Farmers and Fishermen

Province	Year	Population (person)				Fish Production by this Project (kg)	Cost (10 ³ /day)
		1982	1985	1990	2000		
Ayutthaya Province and 4 Other Provinces		106,500	118,200	137,900	176,800	900,000	118,125
Surajthani Province and 4 other Provinces		20,600	22,200	26,700	34,200	1,800,000	220,500
Trang Province and 4 other Provinces		15,900	17,200	20,600	26,400	450,000	54,337.5

Table 6-15 Estimated Fish Expense per Person

Province		Year	1982	1985	1990	2000
Ayutthaya Province and 4 other provinces	Weight (kg)		8.5	7.6	6.5	5.1
	Cost (10 ³)		1.1	1.0	0.9	0.7
Surajthani Province and 4 other Provinces	Weight (kg)		87.4	81.1	67.4	52.6
	Cost (10 ³)		10.7	9.9	8.3	6.4
Trang Province and 4 other Provinces	Weight (kg)		28.3	26.2	21.8	17.0
	Cost (10 ³)		3.4	3.2	2.6	2.1

6-4 Monetary value of the Fish Production Program

The value of production of fish was calculated for each of the species from the target value of production of seed fish in the subject regions and the shipping price (data given by Operation Center, Inland Fishery Division, Department of Fishery, Ministry of Agriculture and Co-operative to the investigation mission), with survival rate at 15%, and weight of fish at 1 kg per 10 fish harvested, and the result is shown in Table 6-16, 17, 18.

Table 6-16 Fish Production and Sales Price in the Ayutthaya Project

Fish Item	Number of Seed Fish (mil.)	Survived Fish (1000)	Produced Fish (kg)	Sales Price/ kg ¥/kg (฿/kg)	Total Sales Price (1000 ¥)
Puntius Gonionotus	10	1,500	150,000	126 (12)	18,900
Tilapia Nilotica	10	1,500	150,000	105 (10)	15,750
Cyprinus Carpio	10	1,500	150,000	105 (10)	15,750
Pangasius Sutchi	18	2,700	270,000	105 (10)	28,350
Oxyeleotris marmoratus	1	150	15,000	735 (70)	11,025
Channa striatus	0.5	75	7,500	315 (30)	2,363
Clarias batrachus	0.5	75	7,500	315 (30)	2,363
Labeo rohita	10	1,500	150,000	157.5 (15)	23,625
Total	60	9,000	900,000	-	118,126

Note: The basic data shown above are presented by the Operation Center, Inland Fisher Division, Department of Fishery Thailand.

Table 6-17 Fish Production and Sales Price in the Ayutthaya Project

Fish	Item	Number of Seed Fish (mil.)	Survived Fish (1000)	Produced Fish (kg)	Sales Price/kg ¥/kg (฿/kg)	Total Sales Price (1,000 ¥)
Tricogaster pectoralis		20	3,000	300,000	105 (10)	31,500
Puntius gonionotus		50	7,500	750,000	126 (12)	94,500
Tilapia nilotica		8	1,200	120,000	105 (10)	12,600
Cyprinus carpio		2	300	30,000	105 (10)	3,150
Pangasius sutchi		20	3,000	300,000	105 (10)	31,500
Labeo rohita		20	3,000	300,000	157.5 (15)	47,250
Total		120	18,000	1,800,000	-	220,500

Table 6-18 Production and Sales Price in the Ayutthaya Project

Fish	Item	Number of Seed Fish (mil.)	Survived Fish (1000)	Produced Fish (kg)	Sales Price/kg ¥/kg (฿/kg)	Total Sales Price (1,000 ¥)
Tricogaster pectoralis		4	600	60,000	105 (10)	6,300
Puntius gonionotus		10	1,500	150,000	126 (12)	18,900
Tilapia nilotica		4	600	60,000	105 (10)	6,300
Cyprinus carpio		2	300	30,000	105 (10)	3,150
Pangasius sutchi		5	750	75,000	105 (10)	7,875
Labeo rohita		5	750	75,000	157.5 (15)	11,813
Total		30	4,500	450,000	-	54,338

6-5 Economic Evaluation

6-5-1 Project Outline

(1) Period of Project

The construction for the project is started in 1982, and the period of project shall be 20 years after starting operation (in 1984), the same period as the one for depreciation of the buildings.

(2) Benefit

Increase of fish production to be expected as a result of seed distribution.

(3) Expenditure

The working expenses shall include personnel expenses, charges for gas, electricity, water, power generation, maintenance, feeding and miscellaneous expenses, and depreciation of instruments and machines; and reinvestment shall be appropriated for the equipments of shorter durable life than the period of project.

(4) Exchange rate of currencies

Conversion of Japanese Yen into Baht in Thailand shall be in the rate as follows: 1 ¥ (Baht) = 10.5 yen

6-5-2 Estimated Expenses

(1) Construction Cost

The construction cost for the project is as shown in tables 6-19 and 6-20, divided into those by the Thailand Government, and Japanese Government. The work by the former is carried out in 1982, while those by the latter is carried out in 1983.

The machines and instruments will finish the durable life of 10 years within the period of the project, and they shall be reinvested 10 years after completion of construction (1994).

Table 6-19 Construction Costs to be Assumed by the Thailand Government

(Unit: 1000 Yen)

Construction Cost	Center	AFC	SFC	TFC	Total
Civil Engineering ¹⁾		40,200	162,400	28,400	231,000
Housing & Office ²⁾		66,600	98,300	40,100	205,000
Total		106,800	260,700	68,500	436,000

1) Civil engineering cost includes construction cost of dikes and main roads

2) Housing & Office cost includes construction cost of office block, staff room and worker room.

Table 6-20 Construction Costs Contributed by the Government of Japan

(Unit: 1000 Yen)

Cost	AFC	SFC	TFC	Total
Construction ¹⁾	333,700	388,800	149,700	872,200
Equipment	46,700	51,200	27,000	124,900
Consultant & Contingency	71,592	82,896	33,912	188,400
Total	451,992	522,896	210,612	1,185,500

1) Construction cost includes the construction of ponds, buildings, roads and pump stations.

Table 6-21 Operation Costs (Unit: 1000 yen)

(Unit: 1000 yen)

Province	Item Year	Personal Expenditure	Running Cost	Maintenance & Operation Cost	Miscellaneous Cost	Total
Ayutthaya	1983	12,600	4,443	9,299	8,400	34,742
	1984	21,000	4,443	9,299	10,500	45,242
	1985	24,150	4,443	9,299	12,600	50,492
	1986	26,250	4,443	9,299	15,750	55,742
Surajthani	1983	15,750	5,337	11,853	8,400	41,340
	1984	26,250	5,337	11,853	10,500	53,940
	1985	28,350	5,337	11,853	12,600	58,140
	1986	31,500	5,337	11,853	15,750	64,440
Trang	1983	4,200	1,255	4,486	4,200	14,141
	1984	10,500	1,255	4,486	7,350	23,591
	1985	18,900	1,255	4,486	9,450	34,091
	1986	21,000	1,255	4,486	11,550	38,291

(3) Calculation of Project Benefits

The direct benefit of the present project is an increase in fish production by distribution of seed fish, and the annual amount is expressed by the sales price for each of the regions as follows: (See Tables 6-16, 6-17 and 6-18)

Ayutthaya	Surajthani	Trang	Total
¥118,126,000	¥220,500,000	¥54,338,000	¥392,964,000

Production of seed fish is started in 1984, but the benefit appears only after catching of the adult fish; and the benefit is calculated for years after 1985.

6-5-3 Economic Evaluation Based on EIRR

Economic Internal Rate of Return (EIRR) was obtained based on previous expenses. It is expressed by the following equation and shows the rate in which the investment during the period contributes to the national economy.

$$\sum_{t=0}^n \frac{B_t - C_t}{(1 + i)^t} = 0$$

i : Economic Internal Rate of Return,
n : Period of Project,
B_t: Benefit in Year *t*,
C_t: Expenses in Year *t*

EIRR of the project for each of the regions and in total are as follows:

Table 6-22

Center	EIRR
Ayutthaya	6.1%
Surajthani	14.0%
Trang	-0.9%
Total	11.0%

Although expenses for investigation, research, training, and promotion activities are appropriated, in addition to those for production of seed fish, the benefit by the expenses cannot be expressed in figures. The EIRR for Trang is the lowest of all and is negative, but Trang Fishery Center is in a way a branch of Surajthani Fishery Center in Character, and EIRR for the total of two centers is 11.0%. These values are appropriate ones as the project as object of economic grant.

The main cause of low EIRR of Trang Fishery Center is that the production of seeds is small, and it can be improved by extension of seed breeding pond by Thailand side in the future, speaking of individual economic efficiency.

The reason why EIRR in Ayutthaya Fishery Center is lower than the average lies in the fact that a large amount is expended in the field not directly connected with seed production; and benefit is expected by propagation of species of high productivity in the future.

EIRR for Surajthani Fishery Center is the highest of all the centers, and this reflects the fact that the main activity is seed production.

Table 6-23

EIRR Calculation Table
(Ayutthaya)

EIRR = 6.1 %

YEAR	COST	BENEFIT	(B-C)	(1000 Yen)
				PRESENT VALUE (B-C)
1982	106800	0	-106800	-106800
1983	472992	0	-472992	-445798
1984	45237	0	-45237	-40184
1985	50487	118125	67638	56629
1986	55737	118125	62388	49231
1987	55737	118125	62388	46400
1988	55737	118125	62388	43732
1989	55737	118125	62388	41218
1990	55737	118125	62388	38848
1991	55737	118125	62388	36615
1992	55737	118125	62388	34510
1993	55737	118125	62388	32526
1994	102437	118125	15688	7708
1995	55737	118125	62388	28893
1996	55737	118125	62388	27232
1997	55737	118125	62388	25666
1998	55737	118125	62388	24191
1999	55737	118125	62388	22800
2000	55737	118125	62388	21489
2001	55737	118125	62388	20253
2002	55737	118125	62388	19089
2003	55737	118125	62388	17991
TOTAL			518893	2247

Table 6-24

EIRR Calculation Table
(Surajthani and Trang)

EIRR= 1 1.0 %

YEAR	COST	BENEFIT	(B-C)	(1000 Yen)
				PRESENT VALUE (B-C)
1982	329200	0	-329200	-329200
1983	766058	0	-766058	-690142
1984	77496	0	-77496	-62899
1985	92196	274838	182642	133546
1986	102696	274838	172142	113395
1987	102696	274838	172142	102157
1988	102696	274838	172142	92034
1989	102696	274838	172142	82913
1990	102696	274838	172142	74696
1991	102696	274838	172142	67294
1992	102696	274838	172142	60625
1993	102696	274838	172142	54617
1994	180896	274838	93942	26852
1995	102696	274838	172142	44329
1996	102696	274838	172142	39936
1997	102696	274838	172142	35978
1998	102696	274838	172142	32413
1999	102696	274838	172142	29200
2000	102696	274838	172142	26307
2001	102696	274838	172142	23700
2002	102696	274838	172142	21351
2003	102696	274838	172142	19235
TOTAL			2030244	-1652

Table 6-25

EIRR Calculation Table
(Surajthani)

EIRR = 14 %

(1000 Yen)

YEAR	COST	BENEFIT	(B-C)	PRESENT VALUE (B-C)
1982	260700	0	-260700	-260700
1983	547046	0	-547046	-479864
1984	53935	0	-53935	-41501
1985	58135	220500	162365	109592
1986	64435	220500	156065	92403
1987	64435	220500	156065	81055
1988	64435	220500	156065	71101
1989	64435	220500	156065	62369
1990	64435	220500	156065	54709
1991	64435	220500	156065	47991
1992	64435	220500	156065	42099
1993	64435	220500	156065	36927
1994	115635	220500	104865	21765
1995	64435	220500	156065	28414
1996	64435	220500	156065	24925
1997	64435	220500	156065	21864
1998	64435	220500	156065	19179
1999	64435	220500	156065	16823
2000	64435	220500	156065	14757
2001	64435	220500	156065	12945
2002	64435	220500	156065	11355
2003	64435	220500	156065	9961
TOTAL			2058654	-1826

Table 6-26

EIRR Calculation Table
(Trang)

EIRR = -0.9%

(1000 Yen)

YEAR	COST	BENEFIT	(B-C)	PRESENT VALUE (B-C)
1982	68500	0	-68500	-68500
1983	219012	0	-219012	-221001
1984	23561	0	-23561	-23990
1985	34061	54338	20277	20834
1986	38261	54338	16077	16669
1987	38261	54338	16077	16820
1988	38261	54338	16077	16973
1989	38261	54338	16077	17127
1999	38261	54338	16077	17282
1991	38261	54338	16077	17439
1992	38261	54338	16077	17598
1993	38261	54338	16077	17758
1994	65261	54338	-10923	-12174
1995	38261	54338	16077	18082
1996	38261	54338	16077	18246
1997	38261	54338	16077	18411
1998	38261	54338	16077	18579
1999	38261	54338	16077	18747
2000	38261	54338	16077	18918
2001	38261	54338	16077	19089
2002	38261	54338	16077	19263
2003	38261	54338	16077	19438
TOTAL			-28410	1613

Table 6-27

EIRR Calculation Table
(Ayutthaya, Surajthani and Trang)

EIRR = 9.4 %

(1000 Yen)

YEAR	COST	BENEFIT	(B-C)	PRESENT VALUE (B-C)
1982	436000	0	-436000	-436000
1983	1239050	0	-1239050	-1132586
1984	122763	0	-122763	-102572
1985	142713	392963	250250	191126
1986	158463	392963	234500	163708
1987	158463	392963	234500	149643
1988	158463	392963	234500	136784
1989	158463	392963	234500	125031
1990	158463	392963	234500	114288
1991	158463	392963	234500	104468
1992	158463	392963	234500	95492
1993	158463	392963	234500	87287
1994	283363	392963	109600	37290
1995	158463	392963	234500	72932
1996	158463	392963	234500	66665
1997	158463	392963	234500	60937
1998	158463	392963	234500	55701
1999	158463	392963	234500	50915
2000	158463	392963	234500	46540
2001	158463	392963	234500	42541
2002	158463	392963	234500	38886
2003	158463	392963	234500	35545
TOTAL			2548537	4630

7 Conclusion and Recommendations

7-1 Project Demand

- (1) In Thailand, a decline in the haul of fish through fish trawling is anticipated in the future; thus, promotion of inland fisheries is very important in view of securing a needed animal protein source for the people. The most important matter at present for increased inland fisheries production is to provide large amounts of seed fish and at a constant rate. The seed production plan which includes training and promotion activities is appropriate from this point of view.
- (2) The demand for fish in all of the three districts is sufficient at present and in the future, and it will be partly satisfied by the production proposed by the project.
- (3) The number of fishing crews unemployed owing to the decline in trawl fishing is estimated to be high in number, and the project is expected to assist the livelihood of farmers and fishermen.
- (4) The anticipated amount of fish production estimated by the project is by no means very large as compared with the populations in the subject regions. However, if the spreading effect into the private sector of inland fishery technology through investigation, research, training, and promotion activities is taken into account, the benefit by the present project can be expected to be great.

7-2 Technical Aspect

- (1) Six of nine species of subject fish are either herbivorous or omnivorous and can be produced in natural water and culturing ponds. The other three are carnivorous and are suitable for extensive and intensive culturing. Seed production of appropriate selection
- (2) The amount of target production from seed fish to adult fish is estimated under the condition of utilizing the proper operation and culturing. The present level of technology in Thailand concerning the species to be used is adequate. The present level of technology in Thailand concerning the species to be used is adequate.
- (3) An object of the breeding program at Ayutthaya Fishery Center is to obtain Stock groups of high productivity and strong vitality. A

considerable length of time and research shall be required for achievement of this aim continuing.

- (4) It is noticeable in Thailand that the efficiency in record keeping is somewhat inferior to the high level of culturing technology. It is important to take accurate records of distributed seed fish (species, total number of seeds, average weight, water quality, etc.) and to carefully examine the results in an effort to improve the management of the project. Accurate recording of data applied similarly to other activities in the centers.
- (5) The technology of fish culturing is advancing rapidly. Therefore, it is important not only to maintain the equipments and operation systems of the centers, but also to actively exchange information and results between the 3 sites in an effort to advance knowledge of culturing techniques.

7-3 Operation and Maintenance procedures

- (1) The Government of Thailand is strongly enthusiastic about the present project and has a control and operation plan which includes pertinent positioning of personnel. For smooth progress of the project, execution according to plan and budget acquisition for the project, by Thailand is essential.
- (2) In order for the project to achieve a highly beneficial effect, it is important not only to attain the anticipated goal of seed fish production but also to assure responsible raising of the seed fish after distribution; and for this reason it is indispensable that training and promotion be emphasized and executed as planned. Considering the importance to the project of the spreading of the culturing technology from the trainees to the local people around them the trainees must be selected among those who will practice fish culturing direct after receiving training.
- (3) Arrangement of pertinent personnel is necessary.
- (4) Many years of experience is required to reach an acceptable level of seed producing technology, and at least one seed production expert must be stationed at each of the centers.
- (5) The Government of Thailand has already decided the numbers of fish to be distributed to each of the districts in the plan, but naturally they should be adjusted according to the actual situation as required.

- (6) The ponds shall be maintained by emptying them completely once a year in order to repair the side walls, expose the bottom sufficiently to dry, make other repairs and to maintain the productivity of the ponds.
- (7) The Trang Fishery center is of small scale and is designed for the production of seed fish as its main activities, thus communication between the Surajthani and Trang Fishery centers is needed to help maintain the technical level at the Trang center.
- (8) As for the discharge into natural waters of the seed fish it will be important to trace the effect this discharge will have on haul levels, amounts of resources, etc.

7-4 Project Recommendations

- (1) The seeds are to be distributed for discharge in natural waters and village ponds under common control, to individuals for domestic consumption, and to aquaculturists.

Generally, the survival rate is lowest in natural waters. The survival rates as well as the production rate increases as the fish breeding is shifted from large-scale extensive breeding ponds to small scale intensive breeding ponds. Later a more effective control system for large pond facilities should be considered and changes in feed expenses and personnel increases considered accordingly.

- (2) In order to elevate the level of expertise of the centers officers, technical experts especially in the field of fish feed, fish disease, genetics, etc. should be trained accordingly.
- (3) Fish culture is an industry where daily control affects the production greatly, and emphasis should be laid not only on discharge of seed fish into public waters but also on technical assistance to private individuals who are now engaging in fish culturing or who will be in the future.
- (4) The Trang Fishery center contains sufficient room for pond extension and it is hoped that at some time in the future the Government of Thailand will find it desirable to extend this centers production capacity.

- (5) Seed production by private activities, after technical development, should be promoted for species with high productivity, so that the spreading effect of the present project be enhanced.
- (6) It is always possible that things received free of charge are not handled with as much care as purchased materials and this must be dealt with during the period of project construction.
- (7) The mutual construction of the centers undertaken by Thailand and by Japan should be kept as agreed and on schedule, and leveling of land and preparation of infrastructure should be completed as planned.
- (8) Concessions should be offered on the materials, to be imported by exemption from the duty and tax.
- (9) The ground leveling of building facilities in the center building block should be completed before the Japanese construction begins in order to ensure the foundation.
- (10) The earth to be utilized by Thailand construction workers for the making of dikes and for ground leveling should be taken from areas recommended in the detailed design prepared by the Japanese Government.

8 Appendix

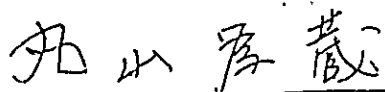
8 - 1 Minutes of Discussion

Minutes of Discussion
on
The Establishment of the Three Inland Fisheries Centers
in the Kingdom of Thailand

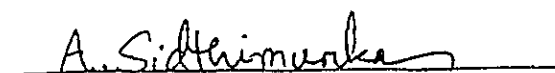
In response to the request made by the Government of the Kingdom of Thailand for the Establishment of the Three Inland Fisheries Centers in Ayutthaya Province, Surajthani Province and Trang Province (hereinafter referred to as "the Project"), the Government of Japan has sent, through the Japan International Cooperation Agency (JICA), a team headed by Mr. Tamezo Maruyama, Chief of the First Laboratory, the Environment Control Division, National Research Institute Aquaculture, Ministry of Agriculture Forestry and Fisheries, to conduct a basic design study for 21 days from April 10th, 1982. The team carried out a field survey, held a series of discussions and exchanged views with the authorities concerned.

As the result of the study and discussions, both parties have agreed to recommend to their respective Governments to examine the results of the survey attached herewith towards the realization of the Project.

April 27th, 1982



Mr. Tamezo Maruyama
Team Leader
The Japanese Basic Design
Study Team



Mr. Ariya Sidhthimunka
Deputy Director General
Department of Fisheries
Ministry of Agriculture and Cooperatives

Attachment

1. The objective of the Project is to provide necessary buildings, facilities and equipment listed in Annex I for the Establishment of the Three Inland Fisheries Centers in Ayutthaya Province, Surajthani Province and Trang Province.
2. The proposed sites of the Project are the lands acquired by the Government of Thailand (hereinafter referred to as "the Project Site"). Each Project Site is shown in annex II.
3. Each Center will undertake its activities with following basic objectives:-
 - (1) The Center in Ayutthaya Province.
 - (a) To produce fish seed.
 - (b) To conduct aquaculture research and genetic study on freshwater fish.
 - (c) To be an extension center to conduct training programs for fishery officers and farmers in Central Region of Thailand.
 - (2) The Center in Surajthani Province.
 - (a) To produce fish seed.
 - (b) To conduct applied research on freshwater fish culture.
 - (c) To be an extension center to conduct training programs for fishery officers and farmers, and to develop fishery resources in the Southern Part of Thailand.
 - (3) The Center in Trang Province.
 - (a) To produce fish seed.
 - (b) To be an extension center for farmers concerning techniques for effective culture and management of freshwater fish.



A. S. K. K. K.

4. The basic design study team will convey the desire of the Government of the Kingdom of Thailand to the Government of Japan to take necessary measures for cooperation in implementing the Project. The Government of Japan will provide the items listed in Annex III in consideration of priority within the budgetary limits of Japanese economic cooperation in grant aid form.
5. The Government of the Kingdom of Thailand will take the following measures, on condition that the grant aid by the Government of Japan is extended to the Project.
 - (1) To provide data and information necessary for the detail design and construction.
 - (2) To secure a lot of land necessary for the construction of facilities.
 - (3) To ensure prompt unloading and customs clearance in Thailand of imported materials and equipment for the construction and also facilitate the internal transportation for them.
 - (4) To exempt Japanese nationals concerned from customs duties, internal taxes and other fiscal levies which may be imposed in Thailand on the occasion of the supply of materials and services under the verified contracts.
 - (5) To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may necessary for their entry into Thailand and stay therein for the performance of their work.
 - (6) To maintain and use properly and effectively that the facilities constructed and equipment purchase under the Grant.



A. S. S. S. S.

(7) To bear all the expense, other than those to be borne by the grant, necessary for construction of the facilities as well as for the transportation and the installation of the equipment.

(8) To conduct the items listed in Annex IV.

6. Both sides confirmed that Japanese basic design study team explained Japans' Grant Aid Programme and Thai side understood it.



A. Sittakorn

ANNEX I

ITEMS OF THE PROJECT

ITEM \ LOCATION	AYUTTHAYA	SURAJTHANI	TRANG	REMARKS
POND				
1. CEMENT POND 50 SOM	20 ea.	20 ea.	10 ea.	
2. EARTHEN POND 400 SOM	60 ea.	-	-	
3. EARTHEN POND 1,600 SOM	26 ea.	48 ea.	14 ea.	
4. EARTHEN POND 3,200 SOM	14 ea.	18 ea.	6 ea.	
5. RESERVOIR.	2.9 ha	2.0 ha	2.0 ha	
BUILDING				
6. CENTRE BLDG.	500 SOM	830 SOM	150 SOM	LABORATORY TRAINING ADMINISTRATION
7. HATCHERY	420 SOM	W/PELLET 500 SOM	250 SOM	HATCHERY STORAGE
8. DORMITORY	530 SOM	530 SOM	-	
UTILITIES & INFRASTRUCTURE				
9. ROAD	ROAD & WATER SYSTEM W/SEWAGE INCLUDING POND CONSTRUCTION			
10. PARKING & GARAGE	INCLUDING BUILDING CONSTRUCTION			
11. PUMP STATION	INCLUDING POND CONSTRUCTION			
12. SIRING	DITTO			
13. EQUIPMENT FOR LAB. & TRAINING	REF. EQUIPMENT LIST			

A.S. A. K. K. K.

ANNEX 11 - SITE DESCRIPTION

1. AYUTTHAYA

- (1) LOCATION: ALONG CHAOPHAYA RIVER AS ADJACENT TO ROYAL HANDYDRAFT CENTER
; ABOUT 20 KM FAR FROM AYUTTHAYA CITY
- (2) SITE AREA; APPROX. 32 ha.
- (3) OBJECTIVE SITE AREA; APPROX. 25.5 ha.
- (4) UNUSED AREA; APPROX. 6.5 ha. FOR TREE CONSERVATION

2. SURAJTHANI

- (1) LOCATION; ALONG THE TAPI RIVER AT BANG-OR
; ABOUT 20 KM FAR FROM THE MOUTH OF TAPI RIVER
; ABOUT 12 KM FAR FROM PUNPIN DISTRICT
- (2) SITE AREA: APPROX. 89 ha.
- (3) OBJECTIVE SITE AREA; APPROX. 89 ha.
- (4) UNUSED AREA; NONE

3. TRANG

- (1) LOCATION; ALONG THE GUNT TANG RIVER AT NA-TOR-MING and ABOUT 7 KM FAR FROM TRANG CITY
; ABOUT 3 KM FAR FROM ROAD NO. 4046
; ABOUT 15 KM FAR FROM THE MOUTH OF TRANG RIVER
- (2) SITE AREA; APPROX. 88 ha.
- (3) OBJECTIVE SITE AREA: APPROX. 21 ha.
- (4) UNUSED; APPROX. 67 ha. FOR FUTURE EXTENSION AND TREE CONSERVATION



A. Sidhimunba

ANNEX III

III-1 LIST OF PRIORITY

ITEM \ LOCATION	AYUTTHAYA	SURAJ THANI	TRANG	REMARKS
POND				
1. CEMENT POND 50 SQM	A	A	A	
2. EARTHEN POND 400 SQM	A ⁺	-	-	
3. EARTHEN POND 1,600 SQM	A ⁺	A ⁺	A ⁺	
4. EARTHEN POND 3,200 SQM	A ⁺	A ⁺	A ⁺	
5. RESERVOIR	A ⁻	A ⁻	A ⁻	
BUILDING				
6. CENTRE BLDG.				
6-1 LABORATORY	A	A	A	
6-2 TRAINING	A	A	-	
6-3 ADMINISTRATION	B	B	B	
7. HATCHERY				
7-1 HATCHERY	A	A	A	
7-2 PELLET PLANT	-	B	B	
7-3 STORAGE	B ⁻	B ⁻	B ⁻	
8. DORMITORY	A	A	-	
UTILITIES & INFRASTRUCTURE				
9. ROAD	C	C	C	PARTLY R.T.G. (MAIN ROAD)
10. PARKING & GARAGE	C	C	C	
11. PUMP STATION	A	A	A	
12. WIRING	B ⁻	B ⁻	B ⁻	INSITE (AROUND POND)
13. EQUIPMENTS FOR LAB. & TRAINING	A	A	A	

NOTE: A⁺ A A⁻ B B⁻ C
 ←
 High priority

A ← B .

III - 2. LIST OF EQUIPMENT

ITEM	PRIORITY & LOCATION	PRIORITY	AYUT-THAYA	SURAJ THANI	TRANG	REMARKS
GENERAL						
1. TYPE WRITER (THAI)		C	2 ea.	2 ea.	1 ea.	ELEC.
2. TYPE WRITER (ENGLISH)		B	1	1	1	ELEC.
3. PORTABLE ELECTRONIC CALCULATOR		C	1	1	1	W/PAPER ROLL
4. TELECOMMUNICATION RADIO		A	-	1	1	UHF/FM W/ACCESSORY
5. RONEO MACHINE		A	1	1	1	W/ELEC. SCANNER
6. PHOTO COPY MACHINE		A	1	1	1	
TRANSPORTATION						
7. 4WD CAR		A	2	2	1	
8. STATION WAGON		A	1	1	1	
9. TRUCK 4.5		A	1	1	1	FISH TRANSPORTATION
10. MICRO-BUS		A	1	1	-	
11. SPEED BOAT		A	1	2	1	
12. RESEARCH BOAT		A	1	1	-	
PELLET PLANT						
13. MIXER		A	-	1	1	
14. PELLETING MACHINE		A	-	1	-	
15. EXTRUDER		A	-	1	1	W/DRYER
HATCHERY						
16. AIRATION SYSTEM		A	2	2	2	SMALL FOR HATCHERY & CEMENT POND
17. AQUARIUM		C	50	50	30	900 ^{mm} x450x450
18. WATER PUMP 100 ^{mm} ∅		B	3	3	2	PORTABLE
19. WATER PUMP 200 ^{mm} ∅		B	3	3	2	PORTABLE
20. SUCTION PUMP 50 ^{mm} ∅		B	3	3	2	UNDER WATER PORTABLE
21. TRAWEL NET 50 ^m		C	4	4	2	20 ^{mm} MESH
22. TRAWEL NET 25 ^m		C	4	4	2	5 ^{mm} MESH
23. FRP TANK 7 ^{m3}		A	10	10	5	
24. FRP TANK 0.85 ^{m3}		A	10	10	5	
25. GRAG CART		C	5	5	2	
26. WEIGHTING SCALE SET		B	2	2	1	SET: 30Kg., 70Kg. AND 100 Kg.



ITEM	PRIORITY & LOCATION	PRIORITY	AVUT-THAVA	SURAJ-THANI	TRANG	REMARKS
LABORATORY						
27. MICROSCOPE		A	2	2	1	
28. STEREO MICROSCOPE		A	2	2	1	
29. ELECTRONIC BALANCE		A	1	1	1	
30. PORTABLE WATER ANALYSE KIT		A	1	1	1	
31. PORTABLE PH METER		A	1	1	1	
32. PORTABLE DO METER		A	1	1	1	
33. REFRIGERATOR		A	2	2	1	STOCKER TYPE 25°C
34. INCUBATOR		A	1	1	1	
35. ELECTROPHORESIS		A	1	-	-	
36. DISTILLER		A	1	1	1	
37. PLANKTON NET		B	2	2	2	
38. CENTRIFUGAL MACHINE 300 ^{mm}		A	1	1	1	
39. TEST STAND		B				
TRAINING						
40. SLIDE SET		A ⁺	1	1	1	PROJECTOR & CAMERA
41. AMPLIFIER SET 200 WATT		A ⁺	AMPL, MIC SPEAKER 4	AMPL, MIC SPEAKER 2	AMPL, MIC SPEAKER 2	AMP, MICROPHONE & LOUD SPEAKER
42. PORTABLE SPEAKER		A ⁺	2	2	1	
43. OVERHEAD PROJECTOR		A ⁺	1	1	1	
44. MOVIE SET 8 ^{mm}		A ⁺	1	1	1	PROJECTOR & CAMERA
45. OPAQUE PROJECTOR		A ⁺	1	1	1	
46. DAYLIGHT SCRFEN (BIG)		A ⁺	1	1	1	
47. DAYLIGHT SCREEN (SMALL)		A ⁺	1	1	1	
48. TRAINING STAND		B	DEPEND	ON LA	OUT	

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ANNEX IV

LIST OF ITEMS BY THE GOVERNMENT OF THE KINGDOM OF THAILAND

ITEM \ LOCATION	AYUTTHAYA	SURAJ THANI	TRANG	REMARKS
BUILDING 1. RESIDENTS 1-1 STAFF RESIDENTS 1-2 WORKERS RESIDENTS	○	○	○	
UTILITIES & INFRASTRUCTURE 2. DIKE ON THE SITE BOUNDARY	○	○	○	W/ROAD & FENCING
3. ACCESS ROAD	○	○	○	
4. MAIN ROAD	○	○	○	
5. WORKS OUT OF SITE 5-1 WIRING OF ELEC. 5-2 SEWAGE	○	○	○	
6. LAND LEVELING	○	○	○	IN ACCORDANCE WITH BASIC DESIGN
7. WELL	○	○	○	

A.S. Atkinson

8-2 Member list of basic design study team for the three fisheries centers in Thailand

Name	Specialty	Occupation
Mr. Tamezo Maruyama	Leader	Ministry of Agriculture, Government of Japan
Mr. Hideki Tomobe	Coordinator	Japan International Cooperation Agency
Mr. Yoshimasa Enomoto	Fishery Engineer	System Science Consultants Inc.
Mr. Noboru Oohashi	Architectural Engineer	OAC Architects, Planners and Engineers Co., Ltd.
Mr. Masato Araya	Ditto	Ditto
Mr. Minoru Yamamoto	Civil Engineer	Ditto
Mr. Yutaka Yoshikawa	Ditto	Ditto

8-3 Climatic Conditions

8-3-1 Temperature, Humidities

Table 8-1 Temperature, Humidities: Bangkok (50 km South to Ayutthaya)

(Unit:Tem(°C) Hum(%))

Item \ Month	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
Average Temperature	26.1	27.6	29.2	30.3	29.8	28.9	28.4	28.2	27.9	27.6	26.7	25.5	28.0
Average Humidity	74	77	77	77	80	81	82	83	85	85	82	76	80

Table 8-2 Temperature, Humidities: Chumphon (150 km North to Surajthani)

(Unit:Tem(°C) Hum(%))

Item \ Month	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
Average Temperature	24.9	26	27.2	28.5	28.3	27.6	27.3	27.3	27.1	26.7	25.7	24.4	26.8
Average Humidity	83	83	79	80	84	84	85	84	85	87	86	82	84

8-3-2 Precipitation

Table 8-3 Precipitation: Ayutthaya

Month Year	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
1974 (mm)	0.0	0.0	26.0	188.5	275.5	127.7	154.2	147.2	239.2	414.0	55.6	0.0	1,628.5
1975 (mm)	61.0	0.0	12.2	41.5	86.9	137.7	173.5	231.9	198.6	211.2	30.3	16.5	1,201.3
Total	61.0	0.0	38.2	230.0	362.4	265.4	327.7	379.1	437.8	625.2	85.9	16.5	2,829.8
%	2	0	1	8	13	9	12	13	15	22	3	0	100

Table 8-4 Precipitation: Surajthani (1974 - 1978)

Month Year	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
1974 (mm)	12.2	28.6	20.2	127.8	280.0	106.0	99.6	134.8	187.4	125.1	277.5	195.2	1,594.4
1975 (mm)	320.4	11.6	2.9	28.9	265.8	139.8	168.7	117.3	295.3	192.5	488.0	95.1	2,126.3
Total	322.6	40.2	23.1	156.7	545.8	245.8	268.3	252.1	482.7	317.6	765.5	290.3	3,720.7
%	9	1	1	4	15	7	7	7	13	9	21	8	100

Month Year	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
1976 (mm)	13.2	0.0	18.0	90.8	186.8	145.0	130.3	141.8	129.9	113.7	404.4	11.3	1,385.2
1977 (mm)	2.0	10.1	35.0	7.0	111.5	190.7	114.5	163.3	212.0	198.8	489.5	66.9	1,601.3
1978 (mm)	49.6	0.0	22.5	75.1	140.1	143.8	184.9	85.0	189.6	172.0	73.4	180.4	1,316.9
Total	64.8	10.1	75.5	172.9	438.4	479.7	429.7	390.1	531.5	485.0	967.3	258.6	4,203.4
%	2	0	2	4	10	11	10	9	12	11	23	6	100

Table 8-5 Precipitation: Trang (1974 - 1978)

Month Year	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
1974 (mm)	0.0	0.0	20.0	68.9	262.9	264.7	166.1	210.8	253.2	139.4	339.7	141.1	1,866.7
1975 (mm)	386.4	32.9	65.7	166.5	327.8	303.4	160.4	98.4	306.9	257.3	327.3	97.7	2,530.7
Total	286.4	32.9	85.7	235.4	590.7	568.0	326.5	309.2	560.1	396.7	667.0	238.8	4,397.4
%	9	1	2	5	13	13	8	7	13	9	15	5	100

Month Year	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
1976 (mm)	0.0	1.0	34.8	130.5	142.2	134.1	551.5	245.8	365.4	164.4	410.0	13.7	2,193.4
1977 (mm)	0.4	0.0	0.0	0.6	147.1	157.7	129.0	277.5	272.9	291.2	150.4	13.5	1,440.3
1978 (mm)	77.7	0.0	23.6	58.3	214.2	228.0	382.4	158.5	192.5	113.4	74.1	78.4	1,601.1
Total	78.1	1.0	58.4	189.4	503.5	519.8	1062.9	681.8	830.8	569.0	634.5	105.6	5,234.8
%	1	0	1	4	10	10	20	13	16	11	12	2	100

JICA