

3-4-2. Mass culture

1) Chlorella sp.

The pure culture chlorella with the density of  $150-200 \times 10^6$  cells/ml is inoculated into 500-l polycarbonate tank and then culture there until the density of  $10-15 \times 10^6$  cell/ml. The chlorella cultured in 500-l tank is inoculated into bigger tank as occasion demands. The tanks of  $37 \text{ m}^3$  capacity in total are used for chlorella culture in Bojonegara Experimental Station (Photo 89). The filtered seawater is sterilized by hypochlorite (10% chlorine) during 24 hours. After neutralized by sodium thiosulfate, the chlorella is inoculated.

The fertilizers used for mass culture of chlorella are ammonium sulfate (ZA), calcium superphosphate (TSP) and Urea. The amount of the above fertilizers are  $150 \text{ g/m}^3$ ,  $30 \text{ g/m}^3$ , and  $10 \text{ g/m}^3$ , respectively. Further, Clewat-32, which is known as metal chelates, is efficient to propagate chlorella in this Station. In this case, the amount of Clewat-32 is 3 to  $5 \text{ g/m}^3$ . The density of chlorella reaches to  $12 - 20 \times 10^6$  cells/ml in mass culture at Bojonegara Experimental Station. The method of mass culture of chlorella is shown in Fig. 77.

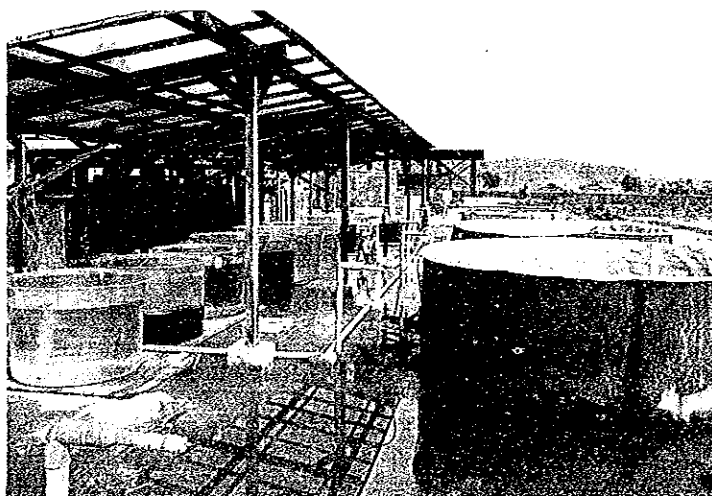


Photo 89 Tanks used for chlorella culture  
in Bojonegara Experimental Station

2) Tetraselmis tetrathele

T. tetrathele showed favorable growth with several fertilizing methods being used for mass culture of chlorella. The various culture experiment were conducted in Bojonegara Experimental Station. The culture method is as follows:

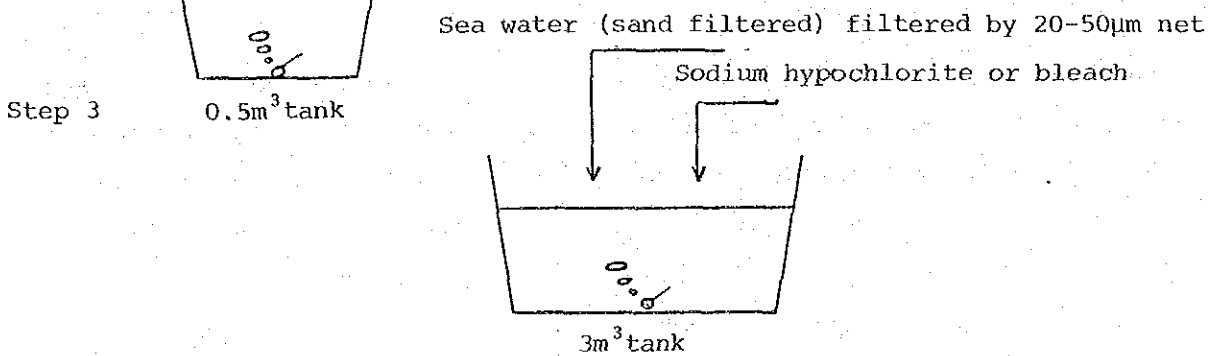
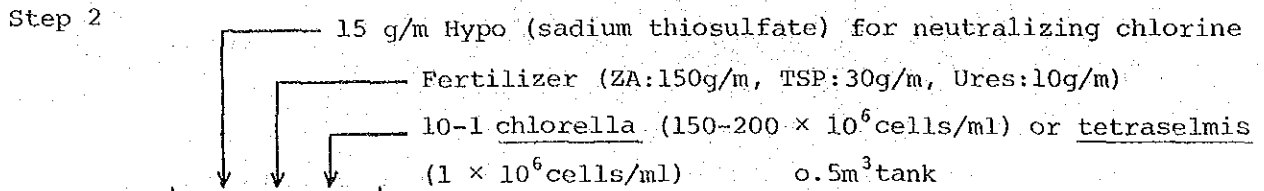
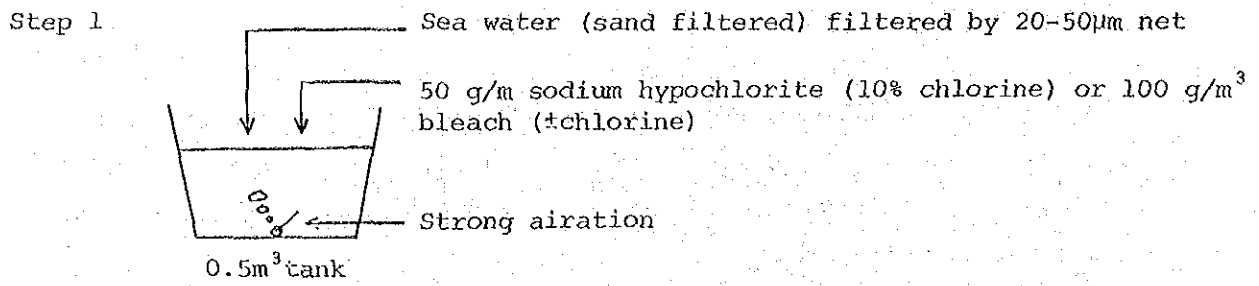
The pure cultured T. tetrathele with the density of 1 to  $1.5 \times 10^6$  cells/ml is inoculated into 1,000-l polycarbonate tank and then cultured there until the density of 3 to  $5 \times 10^5$  cell/ml. The T. tetrathele cultured in 1,000-l tank is inoculated into bigger tank as occasion demands.

The filtered seawater is sterilized by hypochlorite (10% chlordine) during 24 hours after neutralized by sodium thiosulfate, the T. tetrathele is inoculated. The fertilizers used for mass culture of T. tetrathele are ammonium sulfate (ZA), calcium superphosphate (TSP) and urea. The amount of above fertilizers are  $150 \text{ g/m}^3$ ,  $30 \text{ g/m}^3$  and  $10 \text{ g/m}^3$ , respectively. The density of T. tetrathele reaches to 30 -  $50 \times 10^4$  cells/ml in mass culture at Bojonegara Experimental Station. The method of mass culture of T. tetrathele is shown in Fig. 77.

3) Rotifer

The rotifer is used widely in the world for seed production of useful fishes and crustaceans. Generally, rotifer is divided into two types in size, small and large types (S and L types) with 150-250  $\mu\text{m}$  and 250-400  $\mu\text{m}$  in lorica length, respectively.

As the feed of rotifer, chlorella, tetraselmis, marine yeast, raw and dry bread yeasts, etc., are usually used. In Bojonegara Experimental Station, the rotifer, Brachionus plicatilis, introduced from Japan are being used for various seed production experiment. And also the rotifer which was collected in the local area have been cultured in this Station.



Step 4 Density of chlorella:

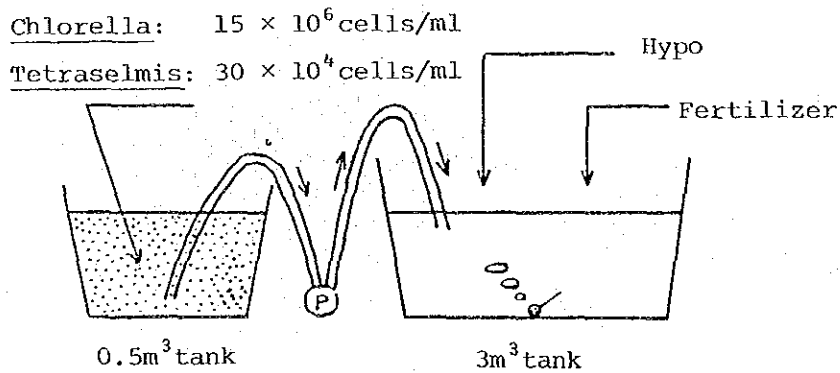


Fig. 77 Mass Production Method of Phytoplankton of chlorella and tetraselmis

Two methods are being used in this Station, that is, filtration thinning method and non-filtration thinning method. The former method is shown in Fig. 78 and Fig 79 shows the result of the daily change of rotifer density cultured in a 30-m<sup>3</sup> tank by feeding chlorella and dry baker's yeast.

At present, the daily production of 60-100 x 10<sup>6</sup> rotifers is attained in the tanks of 10 m<sup>3</sup> capacity in total by using mainly chlorella and T. tetrathele as food in this Station. The daily thinning volume is about 20 to 30%. The maximum density of rotifer which was attained in Bojonegara Experimental Station was 250 ind/ml by feeding chlorella. The thinning is usually done at the density of rotifer from 100 ind/ml to 150 ind/ml.

4) Tigriopus japonicus

Tigriopus japonicus is a copepoda with about 700 μm in length which is used for seed production of fishes as the post-feed of rotifer. T. japonicus inhabits tide pools in coastal area. It has a strong

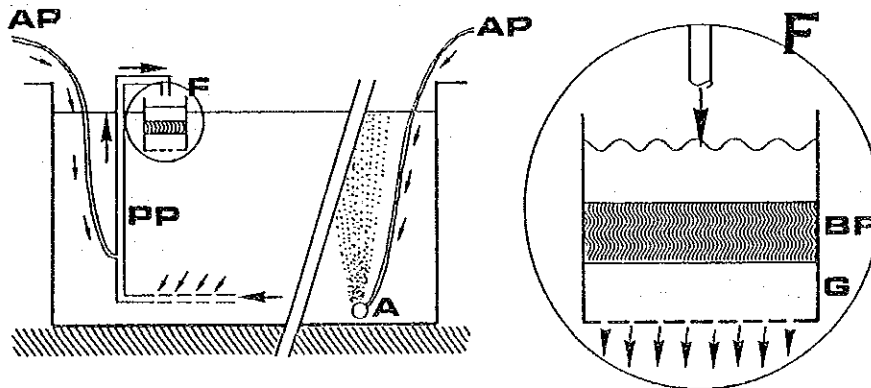


Fig. 78 Schematic Diagram Showing the Culture Tank and Air-lift Filtering System for Cultivation of Rotifer.

AP = air pipe, PP = PVC-pipe, (1.5 inch in diameter), A = airstone, F = filtering apparatus, G = gravel, BF = black sugar-palm fiber

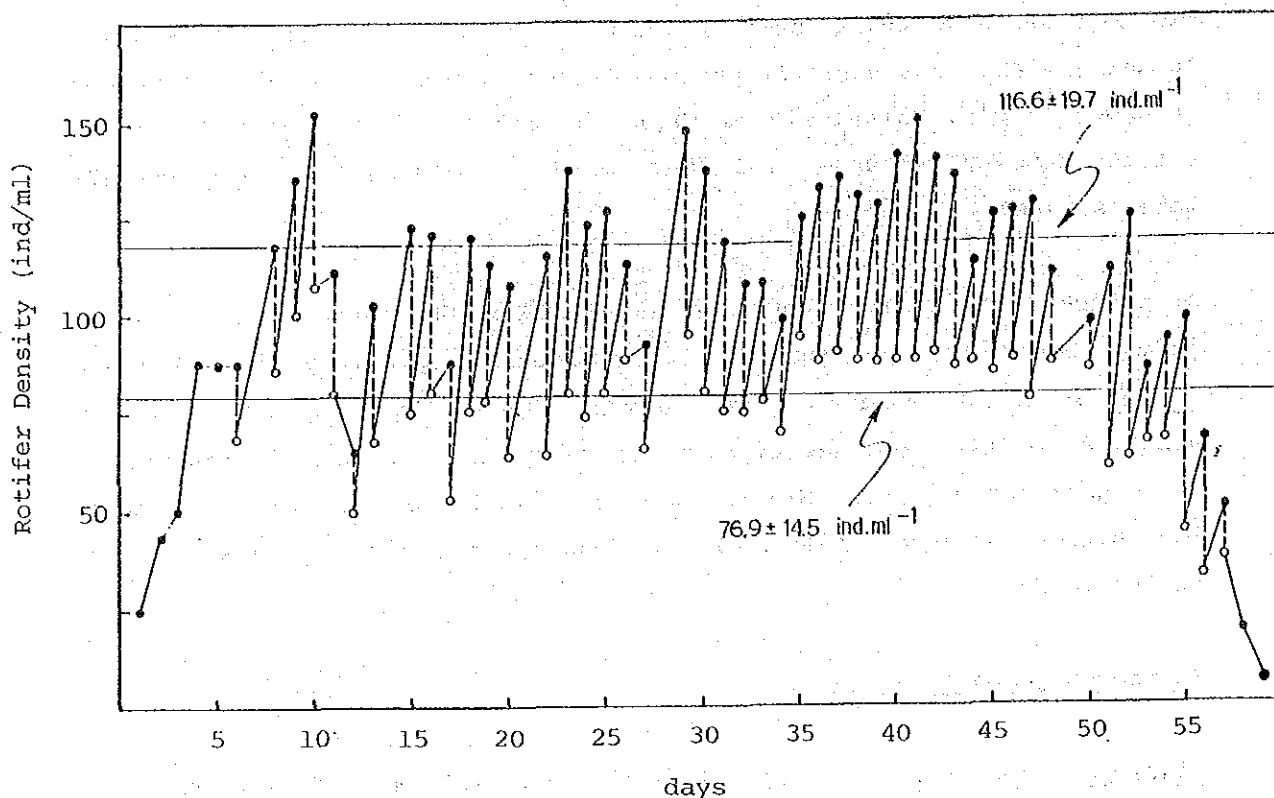


Fig. 79 Daily Variation of Rotifer Density Cultured in Out Doors  
30 m Capacity Tank

resistance against the changes of water temperature and salinity, and it can easily be reared in still water.

In Bojonegara Experimental Station, T. japonicus introduced from Japan are being cultured experiment. T. tetrathele is used for culturing this species and the maximum density was 1,800 ind/l at Bojonegara Experimental Station.

### 3-5 Experimental Production of Formulated Diet

In accordance with development of mariculture industry, formulated diet become to play a more important role. During the period of this project, many kinds of fishes were examined in the various rearing experiment to find the suitable species for mariculture in Indonesia. From the result, the low protein diet is suitable for rabbit fish because they are omnivorous feeder. On the other hand, giant seaperch, snappers, and groupers seem to require high protein diet because they are carnivorous fish.

Fish meal which was produced in Bojonegara Experimental Station, commercial formulated diet for carp, rice bran, wheat flour, vegetable, vitamin mix, mineral mix, etc., were used for producing some kinds of formulated diet and the various rearing experiments were conducted. (Photo 90 - 105, and Fig. 80). The components of the experimental formulated diet produced in Bojonegara Experimental Station are shown in Table 44 - 47.

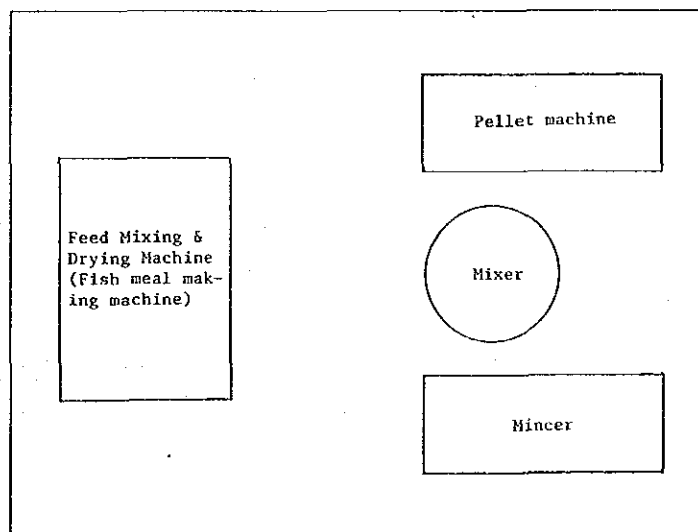


Fig. 80 Arrangement of machines for pellet making



Photo 90 Raw Fish

Photo 91 Process of Making Fish Meal

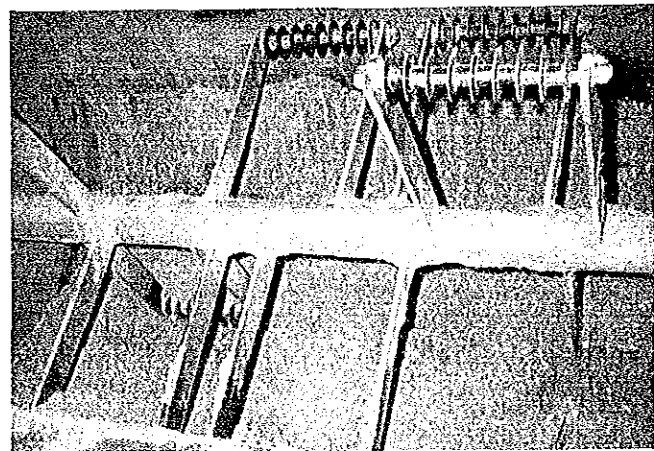
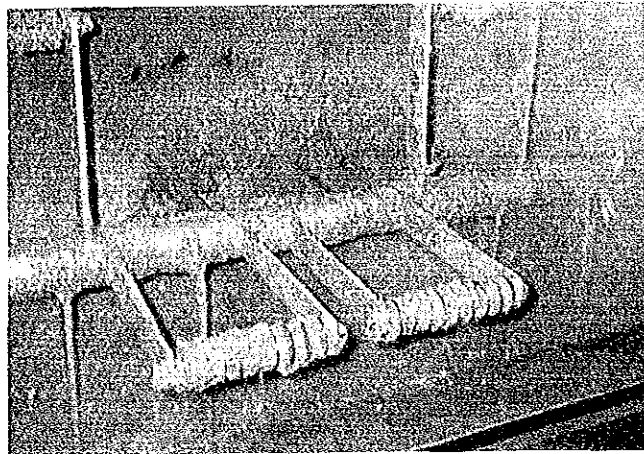


Photo 92 Process of Making Fish Meal

Photo 93 Fish Meal

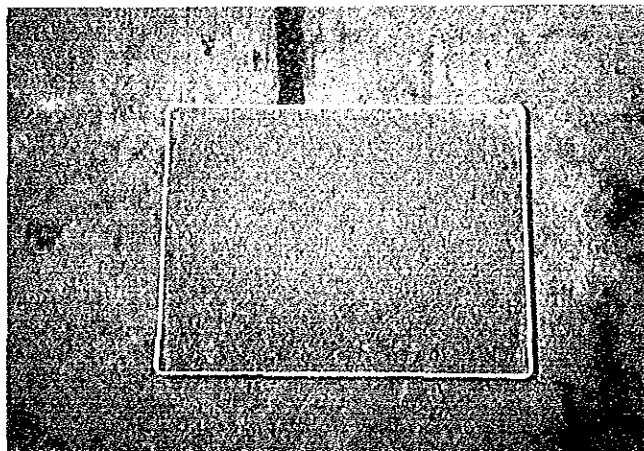




Photo 94 Minceing row fish

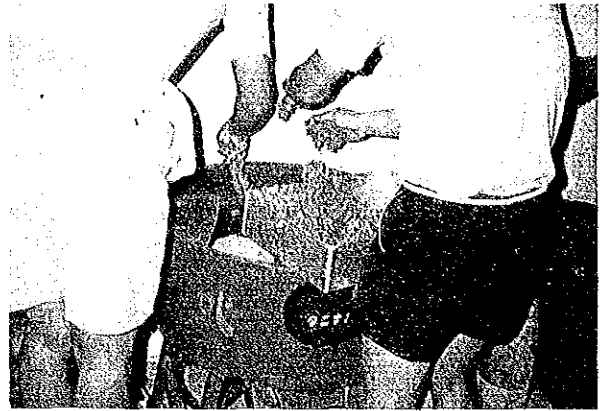


Photo 97 Mixing material



Photo 95 -ditto-



Photo 98 Check of softness

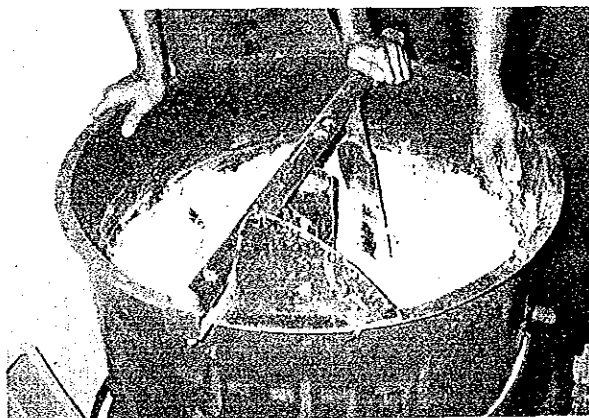


Photo 96 Mixing material

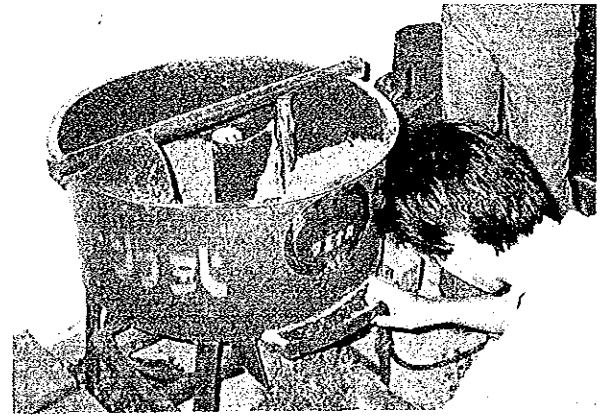


Photo 99 Finished of mixing



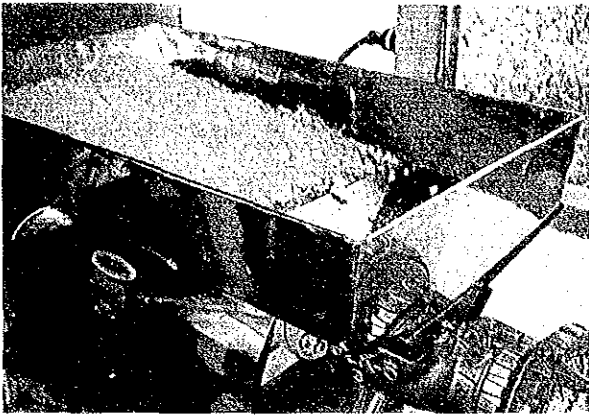


Photo 100 Pelleting

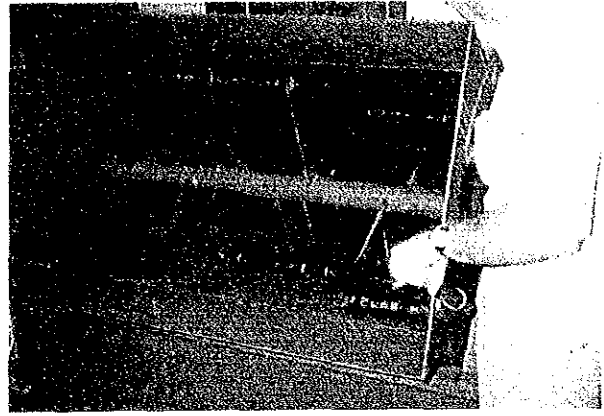


Photo 103 Drying Pellet by Machine

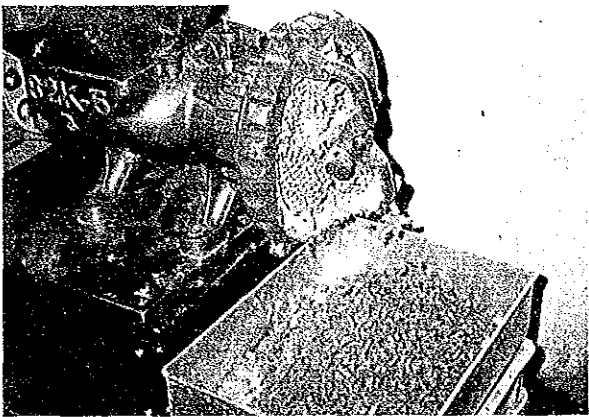


Photo 101 Pelleting



Photo 104 Pellet with Little Wetness

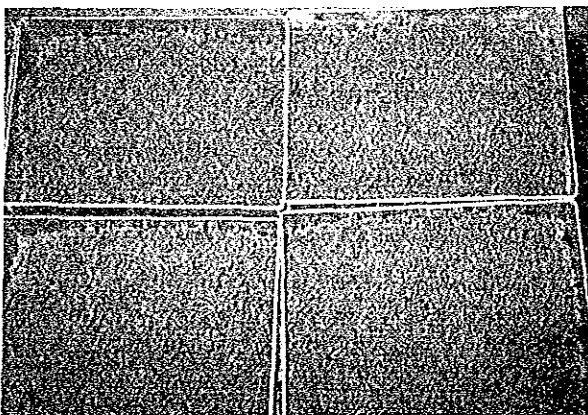


Photo 102 Moist Pellet



Photo 105 Drying Pellet by Sun

Table 44 The Formulated Diets Made in Bojonegara

Material	Price	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
Raw fish	400	10	3.5	6.5	10		10	10	13
Blood	250							5	3
Cabbage	150		1	1.0					
Kangkung	250		0.5	0.3					
Plan meal	600				5	3.5	5	5	3.7
Wheat flour	300		0.5	1	2	3.5	2	3	4
Rice bran	50					1		2	
Formulated diet (carp)	500	10	5	9.2	6	3.4	4.4	5	8
Vit-mix	2000				0.2	0.2	0.2		0.2
Min-mix	1000				0.2	0.2	0.2		0.2
Standard	3000		005	005			005		
CMC	1500				0.2	0.2			0.2
Water						5			
Total		20	10.55	19.45	23.6	17	21.85	30	32.3
Price Rp/Kg		450	424	418	487	341	487	392	454

Table 45 Formulation of Vitamin Premix

Viatmin A	0.20%
B 1	0.02
B 2	0.25
B 6	0.08
B 12	2.00
D 3	0.04
E	7.00
K 3	0.015
C	2.00
Nicotinamide	0.60
Pantothenic acid	0.50
Choline chloride	16.00
Folic acid	0.035
Biotin	0.001
Inositol	0.80
P-Aminobenzoic acid	0.10
Where flour	70.359
<b>Total</b>	<b>100.00</b>

Table 46 Formulation of Mineral Premix

Kel	1.4%
Mg-carbonate	0.7
Fe-sulfate	1.3
Cu-sulfate	0.04
Mu-sulfate	0.15
Za-sulfate	0.17
Co-sulfate	0.01
Ca-phospace	2.54
K I	0.001
Ca-carbonate	0.82
Wheat flour	92.87
<b>Total</b>	<b>100.0</b>

Table 47 General Elements of the Material of Formulation Diets

	Moist	Protein	Fat	Fiber	Ash
Raw fish (sardine)	70.3%	21.4	6.7		1.6
Fish meal	8.9	61.2	6.6	0.1	12.9
Blood meal		55.0	6.0	2.5	21.0
Dry chrysalis	9.3	57.5	29.7		2.6
Soy bean cake	12.1	46.9	1.0	4.6	6.0
Maiza	13.0	9.5	3.9	1.6	1.3
Wheat flour	13.0	8.6	1.3	0.2	0.5
Rice bran	13.4	13.9	30.4	7.4	9.7
Wheat bran	13.7	14.2	3.5	6.3	3.6
Cabbage	89.4	1.7		4.0	0.8
Spinach	93.7	2.3	0.3	0.6	1.3
Formulated diet I (commercial)	12	40	4.5	2	14.5
Formulated diet II (commercial)	12	27	6.0	3.6	10.0

## 3-6 Fish Disease and Parasite

During the period of this Mariculture Project, big mortalities were sometimes observed in floating net cage and in tanks. Concerning rabbit fish big mortality was observed the juvenile in floating net cage from December 1982 to February 1983, March to May 1983, July to September 1983 and April to June 1984. At that time the parasite, the genus Microcotyle was observed from the gill of rabbit fish. The several treatment were conducted with those fishes, however, effective results were not obtained (Table 48).

Table 48 Kinds of Treatment Attempted for Diseases Control

Type of treatment	Materials	Concentration/dosage	Period
Bathing	1. Dipterex*	20 ppm	3 - 15 min
	2. Masoten-20**	50 - 100 ppm	13 - 19 min
	3. Masoten-20	0.5 - 1 ppm	24 hrs
	4. Furanase***	30 - 66 ppm	15 min
	5. Fresh water		10 - 15 min
	6. Salt water	6 - 8%	1 - 2 min
	7. Salt water	80% salinity	10 min
	8. Formalin	1000 ppm	10 min
	9. Ampicillin****	3 ppm	10 min
	10. Eruverju*****	250 ppm	15 min
	11. Eruverju	10 - 15 ppm	24 hrs
Oral medication	1. Furanace	0.03g/kg fish/day	8 days
	2. Ampicillin	20mg activate value/kg fish/day	4 days
	3. Eruverju	0.5g/kg fish/day	10 days

Note: \* Trichloromethyl phosphonate 50%  
 \*\* -ditto- 20%  
 \*\*\* Niflupyrinol  
 \*\*\*\* Aminopenicillanic acid  
 \*\*\*\*\* Sodium nifurstyrenate

From November to December, 1985, fish louse and bacterial disease as the secondary infection were observed with spawners of Siganus guttatus in 10 m<sup>3</sup> concrete tank. Those symptoms were completely cured by using Masoten (Trichloromethyl phosphonate) and Eruverju (sodium nifurstyrenate). Concerning groupers, big mortality was observed with young and adult fish in floating net cage in January 1984 and February 1985. Those big mortality was observed during a short period after turbid water caused by heavy rainfall.

The cause of those big mortality is still unknown. Concerning the countermeasure against parasite and disease, the basic knowledge was learned under the guidance of short-term expert from February to March 1984 and September 1985. And the manual of analytical fish pathology was compiled by the short-term expert and Indonesian researchers. (Photo 106). The researches on parasite and disease are one of future themes in mariculture industry in Indonesia.

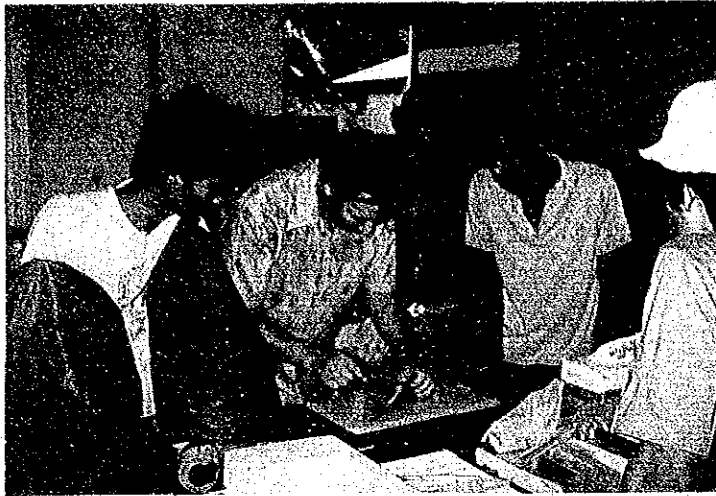


Photo 106 Instructing Fish Diseases and Parasite by Short-term Expert

#### 4. Conclusion

This Mariculture Research and Development Project (ATA-192) has been conducted the various culture experiments and several research surveys. Generally, reproduction process of natural resources and relation to fisheries is shown as Fig. 81 and fish farming development process is shown as Fig. 82. In consideration of those process, many kinds of fishes and shellfishes which inhabit in Banten Bay have been studied and selected for future mariculture industry in Indonesia since more than seven years before in this project. (Table 49 - 51).

The project, as the first mariculture research and development project in Indonesia, has some prominent impacts on the national mariculture development.

Some cooperative works had been carried out between this Experimental Station and educational institutions such as University of Pajajaran (Bandung), University of Diponegoro (Semarang) and Bogor Agricultural University (IPB). More than 20 university students had conducted their thesis research at this Experimental Station.

Some of the results of this project were applied at Tanjung Pinang Research Station for Coastal Aquaculture. The laboratory is using groupers, snappers and oysters as target animals. In addition, some of the private



Fig. 82 Content of technical development in fish farming

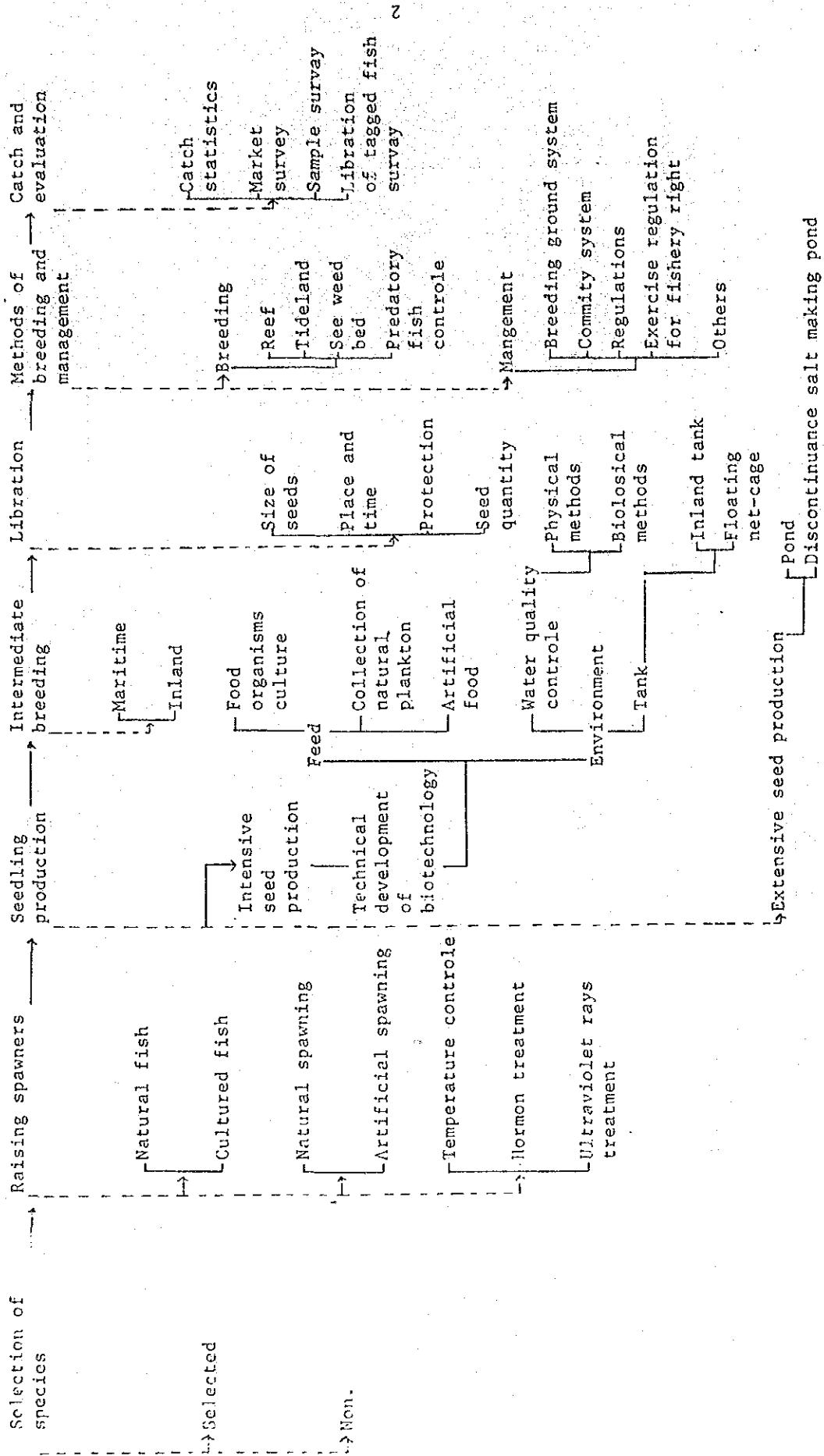


Table 49 Special characteristics of 8 promising species

Species	Seed availability		Growth rate	Food Conversion Ratio	Commercial value at present	Resistance to disease	Requirement of crude protein	Low Salinity Tolerance
	Wild	Artificial						
<u>Lates calcarifer</u>	++	-	High	7 - 8	++	Strong	50	High
<u>Epinephelus tauvina</u>	++	-	High	2 - 4	+++	Strong	50	Low
<u>Lutjanus altifrontalis</u>	+	-	High	7 - 8	+	Strong	50	Low
<u>Lutjanus johni</u>	+	-	High	6 - 7	+	Strong	50	Low
<u>Lutjanus argentimaculatus</u>	+	-	High	7 - 8	+	Strong	50	Low
<u>Siganus canaliculatus</u>	+++	+	Low	4 - 6	+++	Weak	30	Low
<u>Siganus guttatus</u>	+++	+	High	4 - 6	+++	Strong	30	Low
<u>Siganus javus</u>	+++	+	Low	4 - 6	+++	Strong	30	Low

Table 50 Number of fishes and cages for general raising in floating net cages (Jan. 1986)

Species	No. of fishes	No. of cages	
Giant-seaperch : <u>Lates calcarifer</u>	120	5	
Groupers : <u>Epinephelus tauvina</u>	1,762	9	
	<u>E. fuscoguttatus</u>	37	2
	<u>E. morhua</u>	189	1
Snappers : <u>Lutjanus altifrontalis</u>	146	3	
	<u>L. johni</u>	141	2
	<u>L. argentimaculatus</u>	13	1
Rabbitfish : <u>Siganus canaliculatus</u>	4,182	6	
	<u>S. guttatus</u>	153	1
	<u>S. javus</u>	3,495	3
Total	10,238	33	

Table 51 Number of fishes and cage net for rearing as the candidates of spawners (Jan. 1986)

Species	No. of fishes	body weight (kg)	
Giant-seaperch : <u>Lates calcarifer</u>	52	4 - 12	
Groupers : <u>Epinephelus tauvina</u>	49	4 - 6	
	<u>E. fuscoguttatus</u>	37	4 - 5
Snappers : <u>Lutjanus altifrontalis</u>	42	1.5 - 2.5	
	<u>L. johni</u>	171	2 - 4
Rabbitfish : <u>Siganus guttatus</u>	9	0.4	
	<u>S. javus</u>	20	0.2 - 0.3
	<u>S. virgatus</u>	10	0.2
Total	381		



fish farms in this area are practicing new mariculture technologies for some effective and stable operations. The technique of fish culture in bamboo floating net cage was introduced to Ujung Pandang and Pare-Pare, South Sulawesi Province in cooperation with the local Fisheries Office as the field verification trials (Photo 107 - 110).

Director General of Fisheries (GDF) has started establishing a new mariculture development center at Lampung Province. Results of the Project may be of great value to the center.

As the results of this Project, the development of mariculture on fish and shellfish has been accelerated in Indonesia. Especially at Serang, the establishment of the Project has promoted the preference of marine fish such as groupers, snappers, and rabbit fish to the local people in the area. Further, in order to transfer basic mariculture technologies which were established in this project to research laboratories, local fisheries offices and educational institutes concerned, technological manuals were compiled thus far.

1. Shellfish culture (Budidaya kerang-kerangan)
2. Fish culture in the area of Banten Bay (Budidaya ikan laut di perairan teluk Banten)
3. Rotifer culture (Budidaya rotifers)
4. Bamboo floating raft (Kurung-kurung apung bambu)
5. Water quality determination (Penentuan kualitas perairan)
6. Green mussel culture (Budidaya kerang hijau)
7. Analytical fish pathology (Analisa penyakit ikan)
8. Seed Production of marine fish (Pembenihan ikan laut)
9. Phytoplankton culture (Budidaya phytoplankton)

And also all scientific papers and one parts which were written during the period of this project were published.

The list of all scientific papers is as follows:

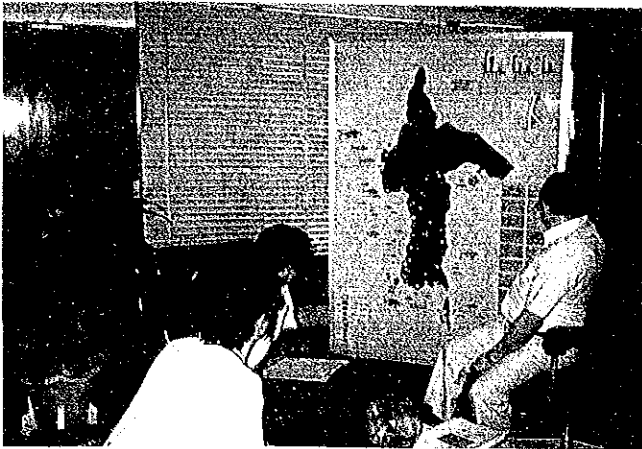


Photo 107 Fisheries Office of Ujungpandang, South Sulawesi

Photo 108 Bamboo Floating Net Cage of Prepare, South Sulawesi

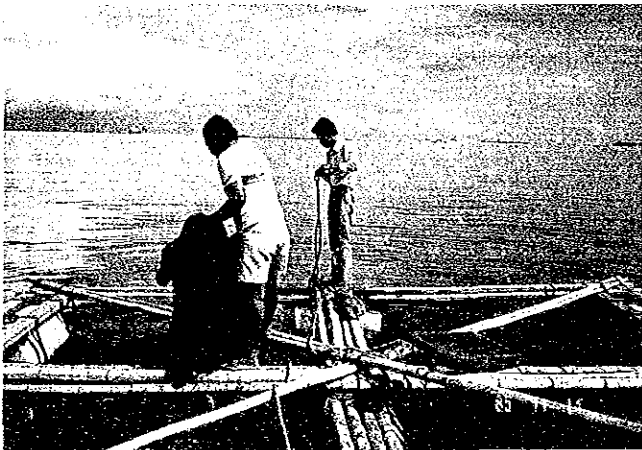
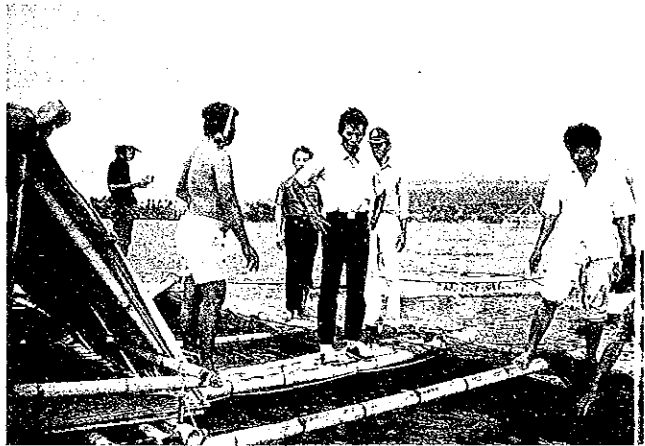
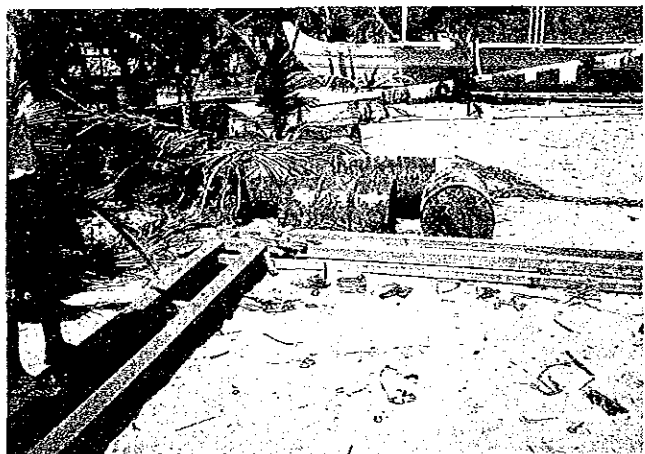


Photo 109 Bamboo Floating Net Cage of Prepare

Photo 110 Construction of Wooden Raft in Ujungpandan, South Sulawesi



TITLE OF SCIENTIFIC PAPERS DURING THE PERIOD OF 1978 - 1986.

1. Growth comparison of some rabbitfish cultured in floating net cages and an attempt on large-scale culture of golden rabbitfish, Siganus guttatus, by using floating net cage.
2. Growth comparison of some commercially important groupers cultured in floating net cage.
3. Growth of giant-seaperch, Lates calcarifer, cultured in floating net cage.
4. Growth of some fish species of the families Lutjanidae, Lethrinidae and Theraponidae cultured in floating net cage.
5. Preliminary observation on the most suitable feeding rate of pearl-spotted rabbitfish, Siganus canaliculatus, cultured in floating net cage.
6. Adequate feeding rate of young giant-seaperch, Lates calcarifer, by using different feeding rates.
7. Supplemental effect of corn oil to the diet of pearl-spotted rabbitfish, Siganus canaliculatus, cultured in floating net cage.
8. Preliminary observation on the suitable diet for fingerling of giant-seaperch, Lates calcarifer.
9. Mass-spat collection of the oyster, Crassostrea iredalei, at Panimbang, Labunan.
10. Induced spawning of some local oysters.
11. Induced spawning and early development of green mussel, Perna viridis.
12. Spat collection of green mussel, Perna viridis, by ropes suspended from rafts.
13. Growth of some oysters cultured by floating rafts and possibility of its culture in Banten Bay.
14. Large-scale culture of green mussel, Perna viridis, by using floating raft.
15. Development of the new type collector, so called Butterfly Rope Collector, for the green mussel culture in Banten Bay.
16. Preliminary study on the optimum amount of fertilizers for culture of marine *Chlorella* by use of the common agricultural fertilizers.
17. Some observation on effect of NPK compound as fertilizer for culture of marine *Chlorella*.
18. Pure culture of some important phytoplankton on mariculture.
19. Culture of the rotifer, Brachionus plicatilis, fed with marine *Chlorella*.

20. Attempts of Copepoda culture in large tanks.
21. Artificial breeding of pearl-spotted rabbitfish, Siganus canaliculatus.
22. Spawning and rearing of larval rabbitfish, Siganus virgatus.
23. Transportation of larval giant-seaperch, Lates calcarifer, from Thailand to Indonesia.
24. Rearing of fry and juvenile of giant-seaperch, Lates calcarifer.
25. Size distribution of giant-seaperch, Lates calcarifer, collected in Sekampung estuary, South Sumatera.
26. Year-round collection of Siganids fry in Banten Bay.
27. Attempts on capture of young commercially important fish to use as seed for floating net cage culture in Banten Bay.
28. Some ecological aspects on spawning of pearl-spotted rabbitfish, Siganus canaliculatus, in Banten Bay.
29. Bottom condition of Banten Bay.
30. Oceanographic environment survey in Banten Bay.
31. Annual observation on appearance of plankton in Banten Bay.
32. Composition of fatty acids in some important edible oils analyzed by gaschromatography.
33. Early development of oyster Crassostrea eradelei under different salinities.
34. Effects of different salinities on the population growth of Tetraselmis sp.
35. Effects of dosages of fertilizers on the population growth of Tetraselmis sp.
36. Relationship between transparency and Chlorella sp. density.
37. Population growth of Copepods cultured in concrete tank.
38. Breeding and larval rearing of Siganus virgatus. Bull. Penel. Perikanan Laut No.30, 1984 pg:35-42.
39. Effects of different salinities on the population growth of Diatom, Chaetoceros simple.
40. Preliminary study on rearing of Groupers, Epinephelus tauvina (Forsk.) in floating net cages.
41. Study on mass culture of Chlorella sp.
42. Mass culture of Rotifer, Brachionus plicatilis.
43. Seasonal changes of Nitrate-N, Nitret-N, Phospate-P and Silicate.
44. On the satiation of Grouper, E. tauvina (Forsk.). Bull. Penel. Perikanan Laut No.30, 1984 pp:63-66.
45. Study on fecundity of Seabass, Lates calcarifer.

46. Observation on the growth rate, daily feeding ratio and food conversion ratio of Lutjanus johni cultured in net cages.
47. Some observation on the growth of Seabass, Lates calcarifer cultured in net cages.
48. Growth rate comparison among Groupers, Epinephelus spp. cultured in net cages.
49. Growth comparison among Rabbitfishes, Siganus spp. cultured in net cages.
50. Experiment on Tilapia culture in sea water pond. Bull. Penel. Perikanan No.1, 1983 pp:37-44.
51. Study on the growth of Red snapper (Lutjanus altifrontalis, Chan) cultured in net cages. Bull, Penel. Perikanan Laut No. 29 pp:61-68.
52. Report of floating net cage culture in Bojonegara Station, S.B.P.B.P. Serang.
53. Report on homemade formulated diet.
53. An experimental culture of grouper, Epinephelus tauvina Forskal, by using raw fish diet.
54. Preliminary study on effect of formulated diet on the growth of red snapper, Lutjanus altifrontalis (Chan, 1970) in the floating net cages.
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57. Preliminary experiment on the nursery of rabbitfish by using fish pen.
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59. A study on the extermination of some parasites, Monogenoidea.
60. Report on the method of treatment for diseases control.
61. Study on the growth of giant-seaperch Lates calcarifer at Sekampung Estuary, Lampung.
62. Study on the spawning season of giant-seaperch. Lates calcarifer in Sekampung Estuary, Lampung.
63. Survey of groupers, Epinephelus spp. fry in Banten Bay.
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66. A study on the mass culture of Teraselmis tetrathele in tropical area.
67. A study on the mass culture of Chlorella sp. in tropical area.

68. Preliminary experiment on the propagation of Tigriopus japonicus using artificial feed for shrimp, dry yeast and Tetraselmis tetrathele.
69. Preliminary experiment of Tigriopus japonicus culture by using only Tetraselmis tetrathele.
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71. Preliminary experiment on the seed production of Siganus guttatus.
72. Effect of stocking density on the growth of grouper, Epinephelus tauvina Forskal, cultured in floating net cage.
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75. Early development of Siganus guttatus.
76. Report of field verification trial in Unjung Pandang.

As the future theme of mariculture industry in Indonesia, research survey is required for selecting the suitable species for mariculture in each local area because Indonesia has very wide sea area and many kinds of fish and shellfish.

In this big sea area of Indonesia, the floating net cage culture has a big potential as the method of mariculture and also the pen culture is considered to be reasonable method in a way of supplemental feeding.

In the stage of developing mariculture industry, the suitable formulated diets for each species should be studied and applied in a commercial way.

The transportation system of commercial fishes should be improved, that is, the system of keeping freshness even on long distance transportation should be established. This is a basic philosophy to develop fishery industry all over the area in Indonesia. Accordingly the development of fish market business, the amount of protein consumption of Indonesian people will be increased because of intaking a larger amount of fish.

At present, the resources of natural seed of fishes are rich in Indonesia, however, those resources seem to decrease in future after development of fishery.

From above reason, the seed production is necessary to develop mariculture industry. And also the seed produced by the seed production will be utilized for liberation to preserve resources of fish.

Further, though food organisms culture for seed production have been established during the period of this project, this technology of food organisms culture should be maintained and developed by Indonesian researchers for prospering not only fish and shellfish culture, but also crustacean culture in Indonesia.

Lastly, considered with the future development of fishery industry in Indonesia, environmental conservation aimed and developed by Indonesian researchers for prospering not only fish and shellfish culture, but also crustacean culture in Indonesia.

#### XIV Acknowledgment

This mariculture research and Development Project (ATA-192) terminates on the day of March 31, 1986. We hereby sincerely express our deepest thanks towards Dr. Gunawan SATARI, Director General of A.A.R.D. (Ministry of Agriculture), Mr. Sofyan ILYAS, Director of C.R.I.F., Mr. A. DWIPONGGO, Dr. Fuad CHOLIK and Mr. Wardana ISMAIL of C.R.I.F., Mr Alie POERNOMO, Director of Research Institute for Coastal Aquaculture, Maros, and Mr. Edward DANAKUSUMAH, Chief of Research Station for Coastal Aquaculture, Bojonegara. We also thank Dr. Purwito MARTOSUBROTO of D.G.F. for his cooperation.

And we acknowledge Mr. SADIKIN S.W. former Director General of A.A.R.D. and Mr. Mochamad FATUCHRI, former Chief of Research Station for Coastal Aquaculture, Bojonegara.

We extend our deep gratitude to Dr. Takeshi NOSE, Dr. Kunihiro FUKUSHO and Dr. Toshihiro MATSUZATO, and other project support committee members in Japan.

In addition, we hereby thank the Fisheries Agency and Japan Embassy of Indonesia. Over again, we express our heartily gratitudes to persons who are concerned with our project.

Lastly, we report the termination of this project to late Mr. Mochammad UNAR who favored his endeavour and assistance as well as instructions and we sincerely pray for the repose of his soul.





Attached Document



Summary Report

on Marine Culture in Northern Coast of Java Island

(April 16, 1975)

J.I.C.A. Experts

D. S. c.      Y. Arakawa  
                  H. Okada

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## Foreword

In compliance with the request of the Government of Indonesia, we conducted field survey in suggested areas suitable for marine culture in northern coast of Java Island for the period between 29th March and 16th April.

It is next to impossible for us to draw a detailed conclusion since our survey period was less than three weeks. Therefore, our impressions through the survey are tentatively summarized as follows:

### I. Outline of the Findings

#### 1) General views

Generally speaking, in northern coast of Java Island, fertile sandy-mud, muddy shoal and dry beach are found covering a wide area.

Therefore, these areas form suitable conditions for the propagation of fish and shellfish used for food, especially of Bivalves, Crustaceans and Mussels.

Besides, the sea areas around islands where coral reefs grow form suitable conditions making use of calm inlet in lagoons for the propagation and reservation as well as cultivation of Pearls mother shells, food or aquarium fishes and Turtles.

#### 2) Regional views

##### a) Banten Bay and its vicinity

Regional survey was conducted on the 2nd of April. This area is considered suitable for the culture of Bivalves and Crustaceans.

In the water around Lima Island, a off-shore island, raft hanging method of oyster culture has been carried out, however, sea area where its average transparency reaches about twenty meters through a year and coral grows naturally is not suitable for the growth of oyster owing to the shortage of feed.

We consider that the vicinity of estauries where its turbidity shows higher is more suitable for the fattening of oyster rather than said area.

##### b) Ketapang (Kauk) coastal area

Regional survey was conducted on the 1st of April. In this area, detritus is abundant and sea bottom consists of fine sand including iron component in plenty. Therefore, the area is

suitable for the propagation of Bivalves, however, owing to over-crowded distribution, their growth is not in good situation.

Under such conditions, the improvement of collecting method (for example, adoption of dredge net) and proper utilization of propagation area are recommendable.

c) Paris Island and its vicinity

Regional survey was conducted on the 4 - 5th of April. This area is surrounded by atoll and calm throughout a year.

In the area, multipurpose utilization for the marine culture such as raft culture of *Margaritifera margaritifera*, *Patina penguin*, *P. fucata* var.; net cage culture of food fish (Yellow-tail, *Epinephelus*); and the culture of aquarium fish, Turtles, Sponges is considered feasible.

d) Djepara coastal area

Regional survey was conducted on the 9th of April. As a project of U.N.D.P., an experimental institute was established in July, 1974 and the pond culture of shrimps is being promoted making use of abolished salt farms.

In this area, the culture of Mullet, Oyster and Quahog (*Anadara* spp.) is also considered promising. Among others, for the hastening of oyster's fattening, the pond culture is considered an experimentation worthy of trying because in this case the control of water quality and feed supply is easily operated.

e) Pangpang Bay and its vicinity

Regional survey was conducted on the 12th of April. This area is a calm inlet facing north and surrounded by the land.

We could observe the cluster of wild oyster, however, all of them were small size.

We regard the Pangpang Bay and its vicinity as the most suitable area among surveyed spots in Indonesia for oyster culture considering existence of a river pouring into the Bay.

Besides, large-sized *Venerupis* sp. inhabits western dry beach and its propagation is also considered feasible.

## II. Supplementary Note

From world-wide view point, until now, the areas where oyster culture has been carried out are limited within higher latitudinal zone from temperate zone to subarctic zone and while, at tropical areas in lower latitudinal zone, the researchers have failed to realize the anti-

pated result. However, oyster culture in lower latitudinal zone may be possible with the advance of study such as selection of suitable species, finding of seasonal change of fattening and experimentation of plantation, etc. and even if the culture should not be successful, it may be possible to find a way as the supplying area of seed oyster since in temperate zone the shortage of seed oyster has been observed in recent years.

### III. Recommendation

For the development of marine culture in Indonesia, we would like to recommend following matters on the basis of our findings.

#### 1) Promotion of research field

a) It is firstly requested to increase younger researcher concerning marine culture and to raise research expenses.

In connection with this, fundamental study on fish and shellfish (classification, ecology, life-history) relating to marine culture should be thought much of and be made progress because fundamental knowledge/information indispensable for the development of marine culture is hardly available yet.

b) Further, for the fullness of technical basis of marine culture, the Authorities should give consideration to source/increase high quality researcher through dispatching younger to developed countries under positive support which aims at forming "a core researcher" who promotes the study, and on the other, should not adopt such an easy-going way of thinking as invites able experts from developed countries and depends entirely upon them.

#### 2) Development of socio-economic background

a) The coastal areas of Java Island have been contaminated by sewage in wide range. Therefore, it is a precondition for the sound development of marine culture to consolidate sewage disposal system and to tighten control over the pollution in coastal areas.

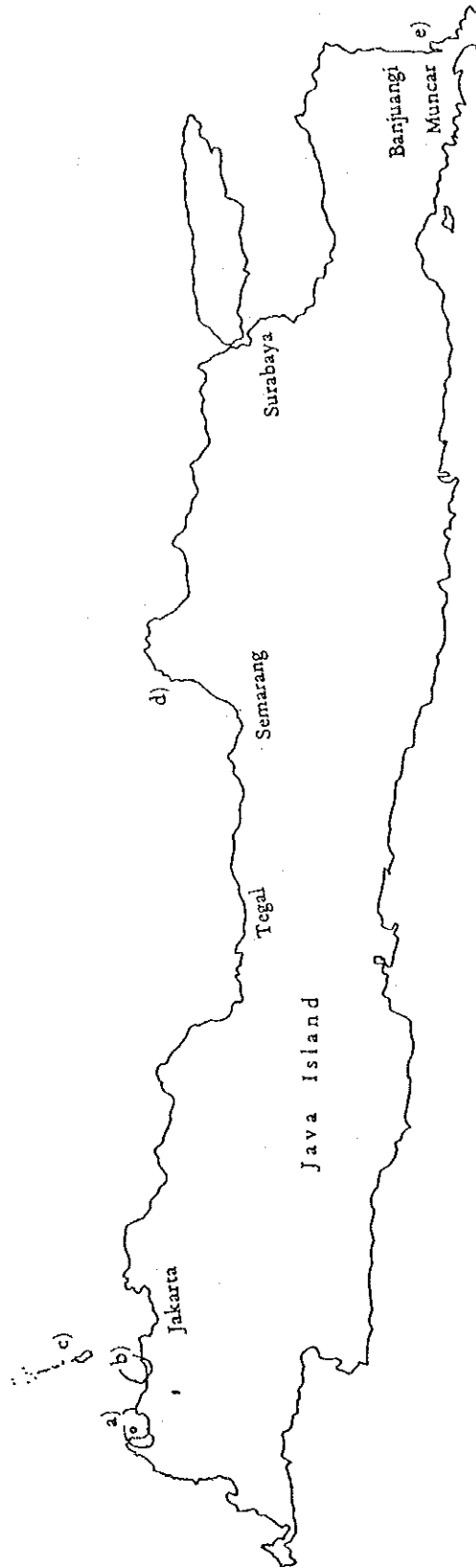
b) Moreover, for the promotion of marine culture the improvement of marketing including the consolidation of related facilities and the increase in consumption of cultural products are also requested.

### IV. Acknowledgement

Taking this opportunity, we should like to express our heart-felt appreciation to the officials concerned, especially staffs of L.P.P.L. whose unlimited cooperation has been most valuable in the execution of our survey.

Survey Area

- a) Banteng Bay and its vicinity
- b) Kepatan (Mauk) coastal area
- c) Paris Island and its vicinity
- d) Djepara coastal area
- e) Panggang Bay and its vicinity





Preliminary Survey Report  
on Favorable Area and Favorable Species  
for the Marine Culture of Fish and Shellfish

(March 25, 1976)

J.I.C.A. Experts  
(Chief) T. Kafuku, D.Sc  
K. Fukusho  
J. Ogawa  
T. Tokutake

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  - 3) Utilization of unexploited resources
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## Foreword:

In compliance with the request of the Government of Indonesia, we conducted fundamental survey in order to find out the favorable areas and favorable species for the marine culture of fish and shellfish. The survey areas were southern coast of Sumatra, northern coast of Java, southern coast of Madura and Bali Island, and the term was from the 1st of March, 1976 to the 23rd of March, 1976.

Through the survey, in Lampung Bay, southern coast of Sumatra, we measured water temperature, specific gravity, pH, transparency of sea water and in most part of other survey areas, observed sea condition and made hearing survey from persons concerned at regional fisheries office and fish market along with fishermen and consumers.

### I. Outline of the Findings

#### 1) Marine culture of fish

##### A) Favorable species

In existing marine culture, speaking generally, the objective fishes are much in demand and expensive. Further, most of them are carnivorous, therefore, cheap fishes that supplied condition is large in amount and stable are served as food for the objective fish.

Consequently, we made a survey of fish price, and in the result, although regional differences are found, Scombroid fishes, *Scomberomorus* spp., *Stolephorus* spp., Clupeid fish, *Rastrelliger* sp. are important and otherwise, *Lutjanus* spp., *Arius* spp., *Epinepheulus* spp. have high market value. Among these, *Epinepheulus* spp., *Lutjanus* spp., *Arius* spp. are considered objective fish for existing culture method because breeding methods of Scombroid fishes (including *Scomberomorus* spp.), *Sardinella* sp., Clupeid fish have not been established yet in the world.

However, even if the culture of objective fish be carried out, there is a fear for maintaining economic advantage otherwise using considerably suitable area owing to the following factors:

- (a) Although some cheaper species such as *Leiognathus* sp. and *Sardinella* sp. are worth notice for food of cultured fish and also suitable for raw material of saled-dry or canned fish, etc., they are in unstable supply in the market.
- (b) Price difference between cultured fish and food fish shows only about several times.

In Japan, for your information, the difference reaches 20 - 30 times and in case increasing one kilo gramme of cultured fish, 7 - 15 times quantity of food fish is needed.

That is, a specialized culture method is able to find own way only in the present instance such as Japan, where live-fishes are valued and the price variation of fish is widely different.

In Indonesia however, at least on marine fish, it is not suitable to introduce culture method being adopted in Japan without any modification.

On the other hand, in culture of milk fish, traditional technics and information have been accumulated in Indonesia. Therefore, it is needless to say that rising productivity and improving culture management of milk fish are urgent business in the fisheries circle.

Further, it seems that the culture of omnivorous and herbivorous fish such as Mugilid fishes, Black sea breams and Siganid spp. should be taken into consideration because in this case, animal protein food is practically not needed.

Besides, it also seems that the pen culture of Mugilid fish and Sea bass making good use of vast brackish water zone and mixed culture of *Tilapia mossambica* aiming at rearing food fish for *Lates carcarifer*, carnivorous fish are recommendable.

#### B) Favorable area

a) Among small bays situated at the southern part of Lampung Bay, especially Rata Bay seems favorable for the floating cage culture of *Lates carcarifer*, *Epinepheulus* spp. and *Lutjanus* spp. Further, Jakarta is not so far, so, Rata Bay has a good condition of location.

b) Small bays in eastern part of Madura, especially Kalianget Bay not far off from the eastern extremity of Madura, seems favorable for the pen culture -- applying technics for constructing "sero" -- of milk fish because in the neighborhood of this area, there are collecting areas of the fry and consuming area of Surabaya.

c) In Benoa Bay, Bali Island, most of its bottom substance are formed by coral reef but partially sandy-mud with the depth of more than 2 meters. In this area, pen culture of milk fish seems promising because the fry of milk fish is easily caught along the northern coast of Bali Island, and Denpasar, consuming area, is close at hand.

d) In Bali Island, Terima Bay facing Java sea is situated nearby western extremity and seems favorable for the pen culture of tropical ornament fish.

#### 2) Marine culture of shellfish

##### A) Favorable species

Throughout the survey area, utilization level of shellfish is still very low, however, the bivalves is most popular as food.

Accordingly, shellfish fishing is nearly in undeveloped stage with the exception of

Anadara fishing in the vicinity of Surabaya using simple gear named "garu".

Judging from beforementioned situation, immediate measures to be taken are to increase production and to promote consumption through generalization of fishing gear and method.

In parallel with this, it is essential to make basic and experimental research on useful shellfish in each favorable area.

In the survey this time, we observed many species of shellfish and among others, consider four species mentioned under favorable ones for the culture.

Food shellfish	Blood shell	Anadara
	Clam	Gafrarium tumidum
	Simping	Amussium pleuronectes
Ornament shellfish	Window pan shell	Placuna placenta

Further, we refer to oyster. Generally speaking, oyster is considered unsuitable species for culture in tropical zone as pointed out in Dr. Arakawas report due to the unfavorable condition for fattening. Our views are same as this and it is not clear that such a lean fattening is caused by tropical environment or by biological characteristics of oyster itself.

#### B) Favorable area

From the biological and economical point of view, we consider that the areas of Lampung in Sumatra and Surabaya including Madura strait are fishing grounds to be developed in the future.

##### a) Lampung and its vicinity

The location of this area has a advantage of existing Jakarta, the largest consuming area in Indonesia and in particular, eastern coast from the inner most recess of Lampung Bay where sandy-mud and shoal beach are found is suitable for the living of Blood shell and there, extensive culture seems possible in the future.

##### b) Surabaya and its vicinity

We consider that Surabaya and its vicinity is the most flourishing area of Anadara fishing. Most of Anadara meat are consumed in the form of fresh or dry and their marketing route has been settled in some degree. In the future, it is desirable to develop existing fishing through motorization of fishing boat and introduction of more effective fishing gear.

Simping is a similar species in ecology to *Patinopecten yesoensis* produced in Japan, therefore, culture method of *Patinopecten yesoensis* may be adopted in Indonesia.

Further, Window pan shell seems a hopeful species to be cultured in the future since it has a high value as ornamental goods.

## II. Suggestion

Based on our findings stated earlier, we would like to suggest following subjects:

### 1) Marine culture of fish

It is not advisable for the marine culture of fish in Indonesia to introduce same method being adopted in Japan without any modification expecting in case trying it in extremely suitable area because obtaining food in stable condition is in difficulty, and price difference between cultured fish and food fish is only several times.

Therefore, the culture method of fishes that need not take animal protein food such as Mugilid fish, Siganid fish and Black sea bream should be paid attention in Indonesia. In this case, we consider that a pen culture modifying "sero" is recommendable. However, in case of pen culture, the stocking fry is liable to reach much amount aiming at the increase of production as seen in Laguna de Bay, Philippine and there is a fear of the fry become short condition.

Generally speaking, it is desirable for the development of marine culture to begin with the accumulation of the result in biological research and fundamental experiments concerning objective fishes.

### 2) Marine culture of shellfish

It seems that the consuming level of shellfish, on the whole, still remains very low, however, only in the area neighboring both Jakarta and Surabaya, we could observe the fishing of shellfish with simple gear.

Therefore, we consider that the increase of production through motorization of fishing boat and introduction of effective gears, and keeping pace with this, the accumulation of fundamental information concerning distribution and spawning season, etc. of hopeful species are essential for the future development of shellfish culture.

### 3) Utilization of unexploited resources

We consider that from the view point of increasing national animal protein intake, the Government of Indonesia should take the measures for the increase of fisheries production through not only the development of marine culture but also the utilization of unexploited resources that inhabit around coastal zone especially inhabit in brackish water area making good use of fresh water area located in inland part.

Furthermore, the culture of milk fish, the most important undertaking in fisheries circle, has been threatened with risky condition due to the fry shortage for these several years.

Therefore, it seems essential to find out suitable fish species for the substitution of milk fish and to try incidental experiments using "tambak"/ fish pond in order to make preparation for such situation.

### III. Supplementary Note

Our findings through the survey are tentatively summarized as stated above, however, there is a fear that our views are attributed to the one-sided observation because the term of survey was about one month and in rainy season severer than usual.

Therefore, we consider that making a survey same as ours in the coming dry season is indispensable for the purpose of drawing overall conclusion.

### IV. Acknowledgement

Taking this opportunity, we would like to express our heartfelt appreciation to the officials concerned including D.G.F., L.P.P.L. and regional fisheries office, and to local fishermen whose unlimited cooperation has been most valuable in the execution of our survey.

3. First Project Formulation Mission with  
the Record of Discussions

1978. 8.15 - 9.2

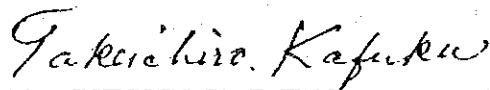
THE RECORD OF DISCUSSIONS BETWEEN  
THE JAPANESE PROJECT FORMULATION TEAM  
AND  
THE AUTHORITIES CONCERNED OF THE  
GOVERNMENT OF THE REPUBLIC OF INDONESIA  
CONCERNING  
THE TECHNICAL COOPERATION FOR  
THE MARICULTURE RESEARCH AND DEVELOPMENT PROJECT (ATA-192)

The Japanese Project Formulation Team (hereinafter referred to as "the Team") organized by the Japan International Cooperation Agency (hereinafter referred to as "JICA") and headed by Dr. Takeichiro Kafuku, visited Indonesia from August 15 to August 30, 1978, for the purpose of working out the details of the technical cooperation program concerning the Mariculture Research and Development Project in the Republic of Indonesia

During its stay in the Republic of Indonesia, the Team exchanged views and had a series of discussions with the Indonesian authorities concerned in respect of the desirable measures to be taken by both Governments for the successful implementation of the above-mentioned Project.

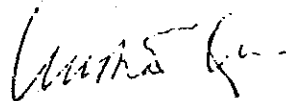
As a result of the discussions, the Team and the Indonesian authorities concerned agreed to recommend to their respective Governments the matters referred to in the document attached hereto.

Jakarta, August 30, 1978



Dr. Takeichiro KAFUKU  
Leader

The Japanese Project Formulation Team



Mohamad Unar  
Director

Marine Fisheries Research Institute

## THE ATTACHED DOCUMENT

- I. Cooperation between the Government of Japan and the Government of the Republic of Indonesia on Mariculture Research and Development Project
  1. The government of Japan and the Government of the Republic of Indonesia will cooperate with each other in implementing the Mariculture Research and Development Project (hereinafter referred to as "the Project") for the purpose of contributing to develop fish and shell-fish culture, which in turn will extend employment opportunities, increase fisheries production and improve fishermen's income.
  2. The Project will be implemented in accordance with the Master Plan which is given in Annex I, provided that the Master Plan may be modified by agreement between the authorities concerned of the two Governments when necessity arises.
  
- II. Dispatch of Japanese Experts
  1. In accordance with the laws and regulations in force in Japan, the Government of Japan will take necessary measures through JICA to provide at its own expense services of the Japanese experts as listed in Annex II through the normal procedures under the Colombo Plan Technical Cooperation Scheme.
  2. The Japanese experts referred to in 1 above and their families will be granted in the Republic of Indonesia the privileges, exemptions and benefits no less favourable than those accorded to experts of third countries working in the Republic of Indonesia under the Colombo Plan Technical Cooperation Scheme.
  
- III. Provision of Machinery and Equipment
  1. In accordance with the laws and regulations in force in Japan, the Government of Japan will take necessary measures through JICA to provide at its own expense such machinery, equipment and other materials necessary for the implementation of the Project as listed in Annex III, through the normal procedures under the Colombo Plan Technical Cooperation Scheme.
  2. The article referred to in 1 above will become the property of the Government of the Republic of Indonesia upon being delivered c.i.f. to the Indonesian authorities concerned at the ports and/or airports of disembarkation, and will be utilized exclusively for the successful implementation of the Project in consultation with the Team Leader referred to in Annex II.
  
- IV. Training of Indonesian Personnel in Japan
  1. In accordance with the laws and regulations in force in Japan, the Government of Japan will take necessary measures through JICA to receive at its own expense the Indonesian Government officials connected with the Project for technical training or study tour in Japan through the normal procedures under the Colombo Plan Technical Cooperation Scheme.
  2. The Government of the Republic of Indonesia will take necessary measures to ensure that the knowledge and experience acquired by the Indonesian Government officials from technical training in Japan will be utilized effectively for the implementation of the Project.



## V. Measures to be taken by the Government of the Republic of Indonesia

1. In accordance with the laws and regulations in force in the Republic of Indonesia, the Government of the Republic of Indonesia will take necessary measures to provide at its own expenses:
  - (1) Services of the Indonesian counterpart personnel and administrative personnel as listed in Annex IV;
  - (2) Land, buildings and facilities as listed in Annex V;
  - (3) Supply or replacement of machinery, equipment, instrument, vehicles, tools, spare parts and any other materials necessary for the implementation of the Project other than those provided through JICA under III above;
  - (4) Transportation facilities and travel allowance for the Japanese experts for the official travel within the Republic of Indonesia;
  - (5) Suitably furnished existing accommodations for the Japanese experts and their families.
2. In accordance with the laws and regulations in force in the Republic of Indonesia, the Government of the Republic of Indonesia will take necessary measures to meet:
  - (1) Expenses necessary for the transportation within the Republic of Indonesia of the articles referred to in III above as well as for the installation, operation and maintenance thereof;
  - (2) Customs duties, internal taxes and any other charges, imposed in the Republic of Indonesia on the articles referred to in III above;
  - (3) All running expenses necessary for the implementation of the Project.

## VI. Administration of the Project

1. Share of responsibility and cooperation from other institutions.

The Director of the Marine Fisheries Research Institute, in consultation with the head of the Agency for Agricultural Research and Development, will be responsible for the administration of the Project and will be the executing agency for the successful implementation of the Project in close cooperation with other institutions.

The Japanese experts will provide technical guidance and advice for the successful implementation of the Project.
2. Establishment of joint-Committee.

In order to execute smooth operation of the Project, a Joint-Committee will be established.

The Joint-Committee will meet regularly at least two times a year and its main task will be to formulate annual operational work plan of the Project, and deal with specific problem(s)

The composition of the Committee is specified in Annex VI.

## VII. Claims against Japanese Experts

The Government of the Republic of Indonesia undertake to bear claims, if any arise, against the Japanese experts engaged in the Project resulting from, occurring in the course of, or otherwise connected with the discharge of their official functions in the Republic of Indonesia except for those arising from the willful misconduct or gross negligence of the Japanese experts.

VIII. Mutual Consultation

There will be mutual consultation between the two Governments on any major issues arising from, or in connection with this Attached Document.

IX. Term of Cooperation

The technical cooperation for the Project under this Attached Document will be valid from the date of the signing of this Record of Discussions until March 31, 1982.

## ANNEX I

### MASTER PLAN

The Project activities will be carried out at existing Ancol Mariculture Laboratory and Experimental Farms to be established in Banten Bay for the purpose of developing the culture techniques on fish and shell-fish, which is selected for the following reasons:

1. Existence of culturable species of fish and shell-fish
2. Situated in the center of fishermen's community
3. Close to the market in densely populated area
4. Close to Ancol Mariculture Laboratory, Marine Fisheries Research Institute

The activities of the Project will consist of studies and development on the following subjects:

#### A. Selection of fishes and shell-fishes suitable for culture development

The most suitable species will be selected through following studies:

- a. Study on seed and fry collection
- b. Study on intermediate breeding
- c. Study on mature specimen
- d. Study on baits and food
- e. Study on mix-culture
- f. Evaluation on items a - e

#### B. Selection on suitable methods for fish and shell-fish culture

The following experiments will be conducted so as to find out low cost culture method to adapt local needs:

- a. Study on traditional methods
- b. Experiment of cage culture
- c. Experiment of pen culture
- d. Experiment of pond culture
- e. Experiment of other methods
- f. Evaluation on items a - e

#### C. Study on natural environment.

The following study will be conducted in order to find out the standard of selecting for suitable site of fish and shell-fish culture in Banten Bay:

- a. Study on water quality and bottom condition
- b. Study on other environment conditions

## ANNEX II

### JAPANESE EXPERTS

Team Leader

Two fish culture experts

One shell-fish culture expert

Coordinator/Liaison Officer

Note:

If necessary short-term experts in the above or other specific fields may be dispatched, based on the consultation with the Director of Marine Fisheries Research Institute.

### ANNEX III

#### THE EQUIPMENT, MACHINERY AND OTHER MATERIALS

1. Machinery, equipment and materials for research and experiment
  - (1) Those for laboratory work
  - (2) Those for field work
2. Machinery, equipment and materials for construction of pond culture
3. Machinery, equipment and materials for management of culture and breeding
4. Audio visual aids
5. Vehicles and small boats
6. Other necessary minor equipment and materials

### ANNEX IV

#### INDONESIAN COUNTERPARTS AND OTHER PERSONNEL

1. Project Manager
2. 6 (six) Counterparts for Japanese experts
3. Experiment assistants
4. Boat operators and car drivers
5. Watchmen (boats and culture facilities)
6. Workers
7. Other administrative personnel including typists and clerks

Note:

At least three counterparts of fish and shell-fish experts and three experiment assistants should be fully stationed at the Project site of Banten Bay.

### ANNEX V

#### LAND, BUILDINGS AND FACILITIES

1. Ancol Mariculture Laboratory
  - (1) Rooms for the experiment and meetings
  - (2) Other necessary facilities for the implementation of the Project
2. Banten
  - (1) Office
  - (2) Experimental farms (including sea water areas)
  - (3) Mooring of boats

- (4) Workshop and garage
- (5) Fresh water wells (three places)
- (6) Housing facilities in farm area
- (7) Store house for machinery, equipment and materials

## ANNEX VI

### COMPOSITION OF THE JOINT-COMMITTEE

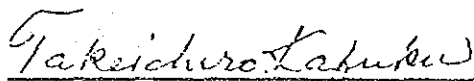
1. Chairman:  
Director of the Marine Fisheries Research Institute
2. Vice Chairman:  
An official appointed by the head of the Agency for Agricultural Research and Development.
3. Indonesian side:
  - a. Project Manager
  - b. Representative of the Bureau of Planning, Ministry of Agriculture
  - c. Representative of Directorate General of Fisheries
  - d. Representative of the Local Government
4. Japanese side:
  - a. Team Leader
  - b. Experts designated by the Team Leader
  - c. Coordinator/Liaison Officer
  - d. Representative of JICA

#### Note:

An official of the Embassy of Japan may attend the meetings of the Joint-Committee as an observer.

The Japanese Project Formulation Team and the Indonesian authorities concerned in the Republic of Indonesia have jointly formulated, with reference to 1-2 of the Attached Document of the Record of Discussions between the Japanese Project Formulation Team and the authorities concerned of the Government of the Republic of Indonesia on the Technical Cooperation of the Mariculture Research and Development Project (ATA-192) the tentative schedule of the Project as annexed hereto.

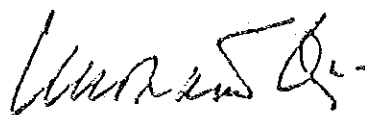
Jakarta, August 30, 1978



Dr. Takeichiro Kafuku

Leader

The Japanese Project Formulation Team



Mohamad Unar

Director

Marine Fisheries Research Institute

TENTATIVE SCHEDULE OF THE PROJECT

Items	'78	'79	'80	'81	Remarks
Survey Team	4	4	4	4	
Dispatching Japanese Experts:					
* Project Leader	Formulation	Advisory	Advisory	Evaluation	
* Two fish culture experts					
* One shell-fish culture expert					
* Coordinator/Liaison officer					
* Short term experts					
Providing the equipment, machinery and materials					
Receiving the Indonesian personnel					
		1st arriving	2nd	3rd	4th
		Study tour & Training	Training	Training	Training
					Amount about 150 million Yen
					Total amount about 370 million Yen

Note:

This schedule is subject to conditions that necessary budget will be acquired for the implementation of the Project.  
 Contents of the schedule are subject to change within the scope of the Master Plan of the said Attached Document Annex I.

View on the results of investigation conducted by the  
Japanese Evaluation Team for Mariculture Research and  
Development Project (ATA-192)

It is two years and nine months with four months more left since the Japanese technical cooperation for this Project started based upon the Record of Discussions signed on August 30, 1978 concerning the Mariculture Research and Development Project in Indonesia. On this particular occasion, the Japan International Cooperation Agency dispatched the Project Evaluation Team to the Republic of Indonesia, headed by Dr. Hisao Sasaoka, Director of Research Planning and Coordination Division, National Research Institute of Aquaculture, Fisheries Agency, for the period from November 4 to November 17, 1981 in order to evaluate the results attained so far.

The Evaluation Team Members, during their stay in Indonesia, looked into the present situation of the Project activities accomplished so far in respective field and the problems left unachieved in the said area of Banten Bay where the Project has been under way. Furthermore, with a common recognition of status quo the Team had a series of discussions with the Indonesia authorities concerned in respect to the measures to cope with hereafter.

I herewith express my view on the results of investigation and on measures necessary to be taken henceforth as shown in the attached sheets.

November 17, 1981

Mariculture Research and Development  
Project Evaluation Team



Hisao Sasaoka  
The Japanese Team Leader



Over-all Evaluation for the results of experiments  
by the Project Evaluation Team

1. Basic Research
  - 1-1 Investigation of fish maturation landed at the market A
  - 1-2 Survey of fish larvae in the field A
  - 1-3 Survey of food organism in the field A
  - 1-4 Observation at the fixed stations in Banten Bay
    - Oceanographic condition B
    - Chemical analysis B
    - Biological survey A
  - 1-5 Environmental condition at the culturing ground A
2. Rabbitfish culture
  - 2-1 Natural fry collection in Banten Bay A
  - 2-2 Experiment of floating cage net culture B
  - 2-3 Pond culture B
3. Carnivorous fish culture
  - 3-1 Survey of natural spawners in Banten Bay and others B
  - 3-2 Natural fry collection in Banten Bay and others C
  - 3-3 Experiment of floating cage net culture C
  - 3-4 Rearing experiment in tanks
    - Raising spawners C
    - Larval rearing C
  - 3-5 Finding of other suitable species for culture C
4. Tilapia culture
  - 4-1 Rearing experiment A
  - 4-2 Fry production A
5. Fry production practice
  - 5-1 Fry production of rabbitfish
    - Induced spawning A
    - Hatching out, and larval rearing
  - 5-2 Fry collection of carnivorous fish
    - Induced spawning C
    - Hatching out, and larval rearing C

5-3	Culture of food organism for larvae	
	Chrollera	B
	Rotifera	B
5-4	Experiment of sea shell larvae as food organism	A
6.	Shellfish culture	
6-1	Survey on planktonic larvae	A
6-2	Seed production	
	Natural seed collection	A
	Artificial seed production	B
6-3	Study on culture method	B
7.	Handling and management of the equipment	B

- Notes :
- A. Experiment can be conducted by Indonesian side
  - B. Indonesian counterparts can conduct experiments by advice and under the guidance of Japanese Experts.
  - C. There are still need to dispatch Japanese Experts in order to achieve the aim of research.

Present situation of the Mariculture Research and Development  
Project (ATA-192) and its future measures to be taken

Summary

It can be considered from the present state that this Project has just reached the stage where its grounding and active movement enough to produce effective results in near future have been built up.

Namely, the basic conditions so as to attain its aim have been satisfied although the Project has not yet reached its goal which had been set at its outset. However, the facilities and organization to make the experiments and research possible in developing the mariculture regarding Banten Bay as a model fishing ground have been established in a greater degree, and also basic knowledge and technique to make an actual plan for mariculture have been nearly acquired through the experiments and research made until now.

The future development is to make the better function of the facilities, and to improve systematically the working force of the personnel.

The Project is now on its way toward promoting full-fledged culture experiments on a considerably large scale by combining basic knowledge and basic technique for practical purposes.

If the experiments are promoted in this direction perhaps over a period of about two years, its aim must be attained, and it seems appropriate to extend the period of this Project accordingly.

It is, therefore, essential for the Indonesian authorities concerned to take positive and concrete steps to put the results of culture experiment into a commercial and industrial basis for the purpose of making this Project successful. In fact, the Indonesian side has so far paid much attention to such matters as 1. Diversion of "Bagan" to shellfish culture purpose, 2. Release and transplanting of artificial shellfish larvae, 3. Making of a manual of fish culture technique, 4. Extension of the technique of sea-water tilapia culture and development of solitary islands, 5. Establishment of such an extension system implemented in the estate crops industry, but a step forward on a realistic basis should be taken. The Indonesian authorities concerned has fully agreed upon these matters above in the Japan-Indonesia Joint Evaluation Meeting.

## By Field

### 1. Basic Research

This research has already clarified its characteristic of location almost sufficiently as a fishing ground of Banten Bay in terms of emergence of fry and spawners, affluence of food organism, and hydraulic and water quality environments.

The selection of the experimental stations has also been properly made based upon the results of the research.

The technique used in the survey has been well mastered in almost all items by the Indonesian side except for immaturity in the survey of bottom sediment, and chemical analysis of water quality.

Consequently, this basic research should be promoted in succession as a regular one hereafter mainly by the Indonesian side, strengthening a part of monitoring water quality.

### 2. Experiments on fish culture

This experiment has being carried out by fish species separating rabbitfish from carnivorous fish respectively, but it is considered effective and practical to take a step hereafter to develop the technique for fry production and raising technique as fish overall.

#### 2-1. Experiments on Rabbitfish culture

This experiment is in remarkable progress.

Such conditions necessary to establish mariculture as fry collection, food supply, management of floating cage nets, and prevention and extermination from parasite have been grasped manysidedly conforming to the present state in Banten Bay.

The question left is to demonstrate how effective culture can be conducted in combination of these knowledge and experiences so far obtained.

It is, therefore, of necessity to promote full-fledged experiments on the technical development for culture based mainly on the technique for raising so that the results of the experiments so far gained may be utilized toward practical purposes.

For this, it is equally important to strengthen the training for rearing work on the sea.

## 2-2. Experiments on carnivorous fish

This experiment has been carried out on Lates and groupers as object fish.

The young and adult fish of Lates cannot be expected to catch in the vicinity of Banten Bay, and on the other hand groupers can be caught only sporadically in Banten Bay, for the reason of which, its technical knowledge has not been well accumulated as yet.

Therefore, it is necessary to put the stress hereafter on the collection of fry and spawners and to promote each experiment in each item needed to establish the culture technique after stocking a considerable amount of experimental fish in floating cage nets or in tanks.

It is also worthy of consideration to diversify the object fish species or to change them to the other species.

## 2-3. Experiments on tilapia culture

This experiment was aimed to intensively produce fish for feed needed for carnivorous fish culture.

These experimental ponds where sea water is introduced have proved to raise higher production than the traditional ponds proper to Indonesia.

Seeing that the price of tilapia has recently gone up, it can be said that this experiment has improved the tilapia culture itself. The problem remains whether or not the results of this experiment should be incorporated into the technical system of the carnivorous fish culture, but it can be considered that its experimental purpose has been well attained.

## 2-4. Technical study on seed production

This study has been carried out with the object of stabilizing the production of artificial seeds of the object fish species for culture, and seeing that the collection of natural seeds in Banten Bay is not sufficient, the significance of this study is great.

As for rabbitfish, its fry production from the spawners by induced spawning has become possible experimentally, but as for carnivorous fish, its experiment has not yet been advanced because it is difficult to obtain its spawners.

Consequently, it is necessary to systematize the supply of initial feed by scaling up the planktonic culture form which is now under way, and as for rabbitfish, there is need to establish its production form, while as

for carnivorous fish, to probe for the possibility of seed production by the use of the various kinds of available fishes which can be obtained without limiting to Lates and groupers.

### 3. Experiments on shellfish culture

This experiment has been smoothly carried out as a whole. As for green mussels, their practical culture method ranging from larval collection to rearing has already been established on a small scale.

The culture for ark shells and oysters is also promising in its prospect.

The question left is to materialize culturing as many kinds of species of available shellfish as possible, and if its full-fledged experiment is developed for coming about two years, a manual will be able to be worked out on culture technique for green mussels, ark shells, oysters, and window shells by means of the field equipment which conform to the conditions of the fishing ground.

### 4. Promotion System

For the purpose of realizing the goal promoting a chain of these experiments and studies hereafter conducted, it is a matter of course to further put the environment of experiments and studies in order as a system, and in addition, in order to connect these results directly to culture industry in the future, such positive steps for establishing the system of technique and guidance should be taken as in the following; 1. Diversion of "Bagan" to shellfish culture purpose, 2. Release and transplanting of artificial shellfish larvae, 3. Making of a manual of fish culture technique, 4. Extension of the technique of sea-water tilapia culture and development of solitary islands, 5. Establishment of such an extension system implemented in the estate crops industry.

On the other hand, as for the improvement on the function of the personnel and existing facilities, there remain such problems to be solved as reliable supply of water and electricity, maintenance of equipment and boats, speed-up of administrative and accounting affairs, and systematization of labor.

These matters should be equally dealt with at the earliest possible date.

The Minutes of Discussions  
concerning  
the technical cooperation  
for  
the Mariculture Research and Development Project  
at  
the 3rd Joint-Committee  
held on September 7, 1982

The Japanese Project Consultation Team (hereinafter referred to as "the Team"), organized by Japan International Cooperation Agency (hereinafter referred to as "JICA") and headed by Dr. Takeshi Nose, Director of Division of Fish Nutrition and Metabolism, National Research Institute of Aquaculture, Fisheries Agency, Japan, visited Indonesia from August 26, 1982 to September 9, 1982, for the purpose of working out a detailed Japan-Indonesia cooperative annual implementation plan (September 1982 - March 1984) concerning the Mariculture Research and Development Project in the Republic of Indonesia (hereinafter referred to as "the Project").

During its stay in the Republic of Indonesia, the Team exchanged views and had a series of discussions with the Indonesian authorities concerned with regard to the above-mentioned plan and the desirable measures to be taken by the Governments of both Japan and the Republic of Indonesia for furtherly successful implementation of the Project in accordance with the Record of Discussions signed on August 30, 1978 and the Record of Discussions of Extension signed on March 31, 1982.

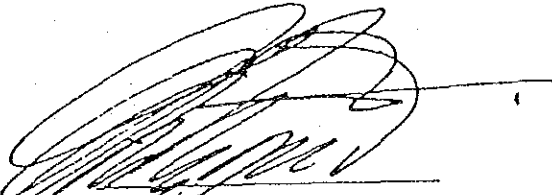
The 3rd Joint-Committee was also held during its stay in the Republic of Indonesia at the JICA Office in Jakarta in accordance with Article VI (Administration of the Project) of the Record of Discussions signed on August 30, 1978 (hereinafter referred to as "the R/D") for the purpose of formulating an annual implementation plan (September 1982 - March 1984) of the Project and dealing with specific matters connected with the implementation of the Project.

THE RECORD OF DISCUSSIONS OF EXTENSION OF THE  
RECORD OF DISCUSSIONS ON TECHNICAL COOPERATION  
FOR THE MARICULTURE RESEARCH AND DEVELOPMENT  
PROJECT (ATA-192)

The Japan International Cooperation Agency (hereinafter referred to as the JICA), had a series of discussions through its Jakarta Office represented by Mr. Moriya Miyamoto with the authorities concerned of the Government of the Republic of Indonesia on the extension of Technical Cooperation for the Mariculture Research and Development Project, based on the Record of Discussions signed at Jakarta on August 30, 1978.

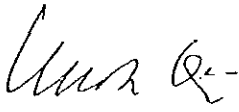
As a result of the talks, the JICA and Indonesian authorities concerned agreed to recommend to their respective Government to extend the period of Technical Cooperation based on the above-mentioned Record of Discussions until March 31, 1984, on the understanding that the cooperation in the field of shell-fish culture will be finalized within one year.

Jakarta, March 31, 1982



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Mr. Moriya Miyamoto  
Resident Representative  
Japan International  
Cooperation Agency



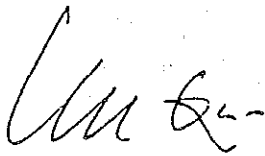
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Mr. Mohamad Unar  
Director  
Central Research Institute  
for Fisheries



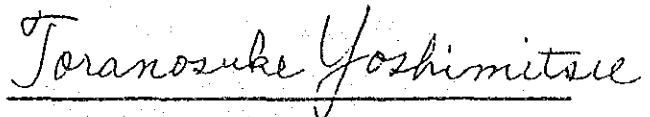
As a result of the discussions at the Joint-Committee, the Japanese and Indonesian sides, composed of such members (including those of the Japanese Consultation Team) as a participants' list attached hereto, made the following minutes of discussions which is attached hereto as Appendix.

September 7, 1982



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Mohamad Unar  
Director  
Central Research Institute for  
Fisheries  
Indonesia



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Toranosuke Yoshimitsu  
Japanese Project Team Leader  
Mariculture Research and Development  
Project  
Japan



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Dr. Takeshi Nose  
Leader  
Japanese Project Consultation Team  
Japan

## Key notes for mariculture research and development

The highly positive intention for the establishment, and further development of mariculture along the coast of Indonesia, especially of Jawa Island, are well recognized by the authorities of both countries. The project will be the first miles stone for these purposes. There would be two phases before the start of establishment of mariculture industry. The first step would be the accumulation of the basic knowledge and the acquirement of technology, and the second phase would be the practical application of these technologies in pilot plant scale. The objective of the Project must be to assist Indonesian side by providing facilities, informations and scientific knowledge for the accomplishment of the first phase and if possible of the start of the second phase.

During the extended period of the Project, one year for shellfish and two years for fish culture, the transfer of background knowledge and basic technology could be expected to be accomplished under the better function of the facilities with systematically organized working forces of the cooperative personnel.

As for the shellfish culture, transfer of knowledge and technology have been smoothly conducted during the first period of the Project, and the starting of practical production in a pilot plant scale would be possible to proceed on a certain species such as green mussels. Also, feasibility studies would be performed on the other species such as ark shell and oyster.

Thus, the shellfish culture could be the most promising part of mariculture being planned to be developed. The representatives of the both sides of Indonesia and Japan at the Meeting understood that the more specified attention must be paid for the high possibilities of the establishment of shellfish culture in Indonesia.

On the other hand, fish culture, especially net cage culture, would be more difficult to establish and to expect rapid development at present. The transfer of background knowledge and basic technology would be able to accomplish within the extended term of the Project, however, so much knowledge and many technologies specified for the target fish must be developed before the commencement of fish culture in practice even in a pilot plant scale. As the cage fish culture industry requires rather sophisticated system, there are several areas that remained untouched within the limited term of the Project. Feed formulation, feeding standard, fish disease, etc. are the areas remained. In addition to technological problems, establishment of fish culture require social needs for cultured fish. Thus, objective of the fish culture sector would be to transfer the knowledge and technology how to find out the target fish adequate for culture and how to evaluate the feasibility of the target fish as cultured species.

The following items of the experiments are intended to list major operational sub-fields in which the Project will carry out mariculture experiments and research during the remaining cooperation period in 1982-1983 Japanese fiscal years.

I. Environmental survey of mariculture ground

The environmental researches have been conducted from the start of the Project and the information about the basic characteristics of experimental mariculture ground at Banten Bay has been obtained. In addition, the surveys in terms of occurrence of fry and spawners, amount of food organisms, as well as hydrolic conditions have been successfully conducted at properly selected experimental stations.

The techniques used in the survey have also adequately transferred in almost all the items to Indonesian side, however, continuation of the research works are still important for more precise background knowledge on environmental characteristics of experimental ground of Banten Bay, especially on bottom sediments, and water quality analysis.

Comparison and combination of data being obtained in the Project and those that will be attained by remote sensing method being planned by Indonesian side will provide full information of Banten Bay as mariculture ground.

The following will be the items to be conducted hereafter.

1. Routine observations of fixed points
2. Plankton fluctuation
3. Bottom condition

## II. Shellfish culture

The high possibility of shellfish culture has been demonstrated during the past period of the Project and the main objective of shellfish research within the extended term of the Project will be the transfer of technology for the total production system from spat collection to final harvest of products using green mussel as representative and promising species for shellfish culture. A long-term farming also must be continued.

Basal physiological and ecological study would also be requested for further development of technology for ark shell and oyster.

The followings are the items to be conducted in the extended term of the Project.

1. Survey on the natural spatfall of bivalves
2. Technical development of culture method

- 1) Green mussel

- Trials on the mass culture

- Investigation on the total production system

- 2) Ark shell

- Basic study on the useful species

- 3) Oyster

- Investigation on Japanese and local oyster

3. Artificial seed production

### III. Fish Culture

During the past term of the Project, fish culture research have been conducted respectively on rabbit fish and other carnivorous fishes. However, fundamental knowledge has been piled up as for the practicability on several fishes as cultured species. Thus, research for general raising technology might be focused on the target fish listed below. Experiments for feeding behaviour would be requested after completion of facilities in Bojonegara station in order to provide additional information for feeding technology.

As for the research works on breeding of spawner and fry production, transfer for knowledge and technology must be confined to certain species due to limited term of the Project. Thus, the general principle must be transferred and further development would be completed by Indonesian side.

The followings will be the items to be conducted in the extended term of the Project.

#### 1. Target species

- |                   |                        |
|-------------------|------------------------|
| 1) Giant seaperch | Lates calcacifer       |
| 2) Rabbit fish    | Siganus spp.           |
| 3) Groupers       | Epinephelus spp.       |
| 4) Tilapia        | Tilapia mossambica     |
| 5) Rotifers       | Brachiounus plicatilis |
| 6) Chlorella      | Chlorella spp.         |
| 7) Others         |                        |

2. General raising
  - 1) Rearing experiments by floating cage nets
  - 2) Rearing experiments by brackish ponds
  - 3) Protection of disease
3. Breeding of spawner
  - 1) Collection of natural immatured fish
  - 2) Raising of spawners
4. Fry production
  - 1) Collection of natural fry
  - 2) Culture of food organisms
  - 3) Induced spawning
  - 4) Natural spawning in cage nets and tanks
  - 5) Larval rearing
5. Experiments of feeding ecology in tanks
  - 1) Satiation amount and time at each growth stages
  - 2) Comparison of foods value.

As reported by the Evaluation Team sent by JICA in November 1981, the basic conditions so as to attain the aim of this project have been mostly accomplished at the main laboratory located at Karangantu.

Thus, experiments and research works have finally come to be possible to exert their full activities for the transfer of background knowledge and basic technology as for the development of mariculture using Banten Bay as a model of mariculture ground. The facilities and installations, however, are not so well completed and organized at the laboratories located at both Bojonegara and Pulau Panjang. The completion of installations at the two laboratories, especially at Bojonegara, must be achieved as immediately as possible for the attainment of the goal of the Project, due to research activities of fish sector and seed production sector being strongly depending on the facilities available at laboratories, especially on those at Bojonegara.

## Technical Manual

The Japanese side agrees that the Japanese Project Leader and the Indonesian Project Manager will furtherly take into consideration and reach a final decision with regard to whether or not JICA makes a technical manual on fish and shellfish cultures and presents it at the end of the Project.

Such a manual may integrate all the important and useful mariculture-related data and other information, including Japanese experts' comments and recommendations which have been and will be accumulated and/or developed through the cooperative experiment and research works of the Projects.



WORKING SCHEDULE OF SWEDISH SECTOR FOR MARICULTURE RESEARCH AND DEVELOPMENT PROJECT (FISCAL YEAR 1982)

Items	1982												1983			Others				
	4	5	6	7	8	9	10	11	12	1	2	3								
I. Environmental survey																				
1) Fixed point observation	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u
2) Plankton fluctuation	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u
3) PSP survey	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u
4) Bottom condition	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u
5) Planktonic larvae & Spat collection	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u
Handbook making																				twice a month.
Water quality & heavy metal by I.P.I																				Handbook making
2nd survey																				twice a month.
Report making																				once a month.
Handbook making																				Handbook making.
II. Technical development																				
1) Green mussel spat collection for mass culture																				
technical study for spat collection																				
investigation on production system																				
2) Ark shell																				
artificial bottom culture substrate																				
basical study on useful species																				
3) Oyster																				
investigation on transplantation																				
trial on reproduction																				
investigation on local oysters																				
4) Others																				
Artificial seed production																				
trial on food culture																				
trial on seed production																				
Handbook making																				by artificial seed production
with same biological studies.																				by counterpart.
Handbook making																				Handbook making.
with same biological studies.																				with same biological studies.

WORKING SCHEDULE OF FISH SECTOR (FISCAL YEAR 1982, 1983)

Items.	Month																								
	1982			1983			1984			1984															
	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
<u>1. General raising</u>																									
1) Rearing experiment by floating cage nets			Rabbitfish, Giant sea perch, Groupers and Others																						
2) Rearing experiments by brackish ponds																									
3) Protection of disease																									
<u>2. Breeding of spawners</u>																									
1) Collection of natural immature fish																									
2) Raising spawners																									
<u>3. Fry production</u>																									
1) Collection of natural fry																									
2) Culture of food organisms																									
3) Induced spawning																									
4) Natural spawning in cage nets and tanks																									
5) Larval rearing																									
<u>4. Experiments of feeding ecology</u>																									
1) Satiation amount and time at each growth stages																									
2) Comparison of foods value																									

THE JOINT EVALUATION REPORT  
O N  
MARICULTURE RESEARCH AND DEVELOPMENT PROJECT (ATA - 192)

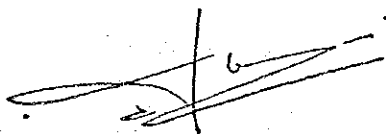
Leaving six months till the termination of cooperation period on March 31, 1984 as stated in the Record of Discussions of Extension of the Record of Discussions (hereinafter referred to as "the Extension R/D"), the Joint Evaluation Team (hereinafter referred to as "the Team") was organized for the purpose of reviewing the achievement of the Project within extended period and giving recommendations for future cooperation.

The team, which consisted of the Indonesian team headed by Mr. Sofyan Ilyas, Director of Central Research Institute for Fisheries, Agency for Agricultural Research and Development, Ministry of Agriculture and the Japanese team headed by Dr. Takeshi Nose, Leader of Japanese Evaluation Team organized by Japan International Cooperation Agency, conducted an evaluation of the project from September 30 to October 5, 1983.

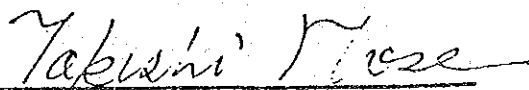
After visiting the project site and conducting a series of discussions with authorities and experts concerned, the Final Joint Evaluation Meeting was held in Jakarta on October 5, 1983.

As a result of the meeting, the Team presented its evaluation report and accordingly agreed to recommend to both Governments through their respective agencies, extension of the project for another two years which referred to in the attached document.

Jakarta, October 5, 1983.



Mr. Sofyan Ilyas  
Leader of the Indonesian  
Evaluation Team.



Dr. Takeshi Nose  
Leader of the Japanese  
Evaluation Team.

#### 4. RESULTS OF EVALUATION

The Joint Evaluation Team recognizes that in general the research activities have progressed considerably and improved except some parts in the field of fish culture. The results of evaluation on respective section are tabulated in Annex III. The outlines are as follows :

##### 4.1. Project Activities on Research and Technical Development

During the extended period, several facilities have been recently constructed or renovated and at present the basic physical conditions are satisfactory to conduct research works and experiments for the attainment of the aim of the project, though rearrangement and repairment are still needed for some facilities and equipments as pointed out in other section.

The improvement of basic research condition accelerated the activity of the project to a great extent. Noticeable progress has been accomplished in accumulating background knowledge and useful technology especially in various fields such as culture of feed organisms, in -duction of spawning, larval rearing and others. The higher technology essential for the development of mariculture, in regard to Banten Bay as a model prior to expand to the coast of Indonesia, is now expected to be transferred to the Indonesian side under the better function of facilities and the systematically organized working forces of the personnel responsible for carrying out research and experiments.

The project is now getting closer to the completion of its goal, however, several research items especially in the fish culture section still require more times for elaboration, accumulation of knowledge and transfer of technology due to the constraints characteristic to intensive fish culture.

The summary of the evaluation on each respective research items are as follows :

##### 4.1.1. Environmental Survey of Mariculture Ground

Routine ecological observation of the environment and plankton fluctuation at fixed points has been carried out efficiently. However, survey of bottom sediment and chemical analysis of water quality needs to be improved.

#### 4.1.2. Shelfish culture

On green mussel, practical culture methods ranging from larvae collection to harvest have been established in fairly large scale. The practical knowledge and technology obtained so far might be applicable to the culture of oyster, ark-shell, and other possible species by Indonesian side. The newly introduced high technology on artificial seed production should be developed especially for stable oyster production.

#### 4.1.3. Fish culture

Intensive research has been conducted for finding adequate species as target for fish culture and 19 species are being raised as test fish in floating net cages. Distribution survey of immature and mature fish as well as of larvae and fingerling has also been extensively conducted. With the aid of newly constructed facility, namely wet laboratory, background knowledge and technology has been accumulated considerably and being transferred to the Indonesian side especially in the field of artificial spawning, larval rearing and culture of food organisms.

In order to establish totally organized production system, technology for feed preparation, feed formulation, disease control should be developed rapidly. Investigation of extensive way of fish culture such as pen culture and sea water pond culture should also be encouraged

#### 4.1.4. Handling and management of equipment and facilities

Fundamental equipments and facilities are mostly well maintained, however, some of them remain in disorder due to lack of knowledge or hindered disbursement of fund for repair. The facilities and equipment should be kept in available condition for smooth operation of research works and experiments.

EVALUATION FOR THE RESULTS OF RESEARCH WORKS

1. ENVIRONMENTAL SURVEY OF MARICULTURE GROUND.
  - 1.1. Routine observations of fixed points A
  - 1.2. Plankton fluctuation A
  - 1.3. Bottom condition B
  
2. SHELLFISH CULTURE
  - 2.1. Survey on the natural spat fall of bivalves A
  - 2.2. Technical development of culture method
    - a. Green mussel A
    - b. Ark shell A
    - c. Oyster A
  - 2.3. Artificial seed production
    - a. Trials on feed organism culture A
    - b. Trials on seed production for gathering basic biological knowledge A
  
3. FISH CULTURE
  - 3.1. General raising
    - a. Rearing experiments by floating net cages A
    - b. Rearing experiments by sea-water ponds B
    - c. Protection of diseases C
  - 3.2. Breeding of spawner
    - a. Collection of immature fish B
    - b. Raising spawners B

3.3. Fry Production

- a. Collection of natural fry A
- b. Culture of food organism B
- c. Induced spawning B
- d. Natural spawning in net cages and tanks B
- e. Larval rearing C

3.4. Experiments of Feeding B

4. HANDLING AND MANAGEMENT OF EQUIPMENTS AND FACILITIES B

Notes : A. Experiment can be conducted by Indonesian side

B. Indonesian counterparts can conduct experiments by advice and under the guidance of Japanese Experts.

C. There are still need to dispatch Japanese Experts in order to achieve the aim of research.

## 5. RECOMMENDATION

The project is to terminate on March 31, 1984. However, in consideration of the objectives and background described in annual plan by the 3-rd Joint Committee and in order to attain the aim of research subjects particularly in the field of fish culture, as well as to assemble all the aquanted information and knowledge on fish culture into total system prior to start of pilot scale culture project, it is recommended to both government of Japan and Indonesia through their repective agencies that the technical cooperation period should be extended for another two years after the termination of the present cooperation stated in the ExtentionR/D. During the second extended period, cooperation listed in Annex 5 is requested for the development of research activities on respective items listed in Annex 6.

Publication of research results and manuals is highly recommended to disseminate the information to users.



ANNEX 5.

1. DISPATCH OF JAPANESE EXPERTS

A team of fish culture experts

Note : If necessary, short-term experts in the above or other specific fields may be dispatched, based on the consultation with the Director of Central Research Institute for Fisheries (CRIFI).

2. SUPPLY FOR THE EQUIPMENT AND MATERIALS

- 2.1. Equipments, spare parts and other materials for laboratory work.
- 2.2. Equipments, spare parts and other materials for field work.
- 2.3. Other necessary equipments and materials.

3. TRAINING OF INDONESIAN PERSONEL IN JAPAN

ANNEX 6.

THE ACTIVITIES OF THE PROJECT WILL CONSIST OF STUDIES ON THE FOLLOWING SUBJECTS:

1. General Raising

- a. Rearing experiments by floating cage nets
- b. Rearing experiments by sea-water ponds and pen culture
- c. Protection against parasite and disease.

2. Breeding of Spawner

- a. Collection of natural immature fish
- b. Raising of spawners

3. Fry Production

- a. Collection of natural fry
- b. Culture of food organism
- c. Induced spawning
- d. Natural spawning in cage nets and tanks
- e. Larval rearing

4. Feeding Experiment

5. Field Verification Trials (in collaboration with Sea Farming Development Centre, Directorate General of Fisheries)

- |                   |                         |
|-------------------|-------------------------|
| a. Giant seaperch | <u>Lates calcaFifer</u> |
| b. Rabbit fish    | <u>Siganus spp.</u>     |
| c. Groupers       | <u>Epinephelus spp.</u> |
| d. Snappers       | <u>Lutjanus spp.</u>    |
| e. Rotifers       | <u>Brachionus spp.</u>  |
| f. Chlorella      | <u>Chlorella spp.</u>   |
| g. Marine yeast   |                         |
| f. Others         |                         |

8. R/D OF SECOND EXTENSION

THE RECORD OF DISCUSSIONS ON EXTENSION OF THE PERIOD  
OF THE TECHNICAL COOPERATION FOR THE MARICULTURE  
RESEARCH AND DEVELOPMENT PROJECT (ATA-192)

The Japan International Cooperation Agency (hereinafter referred to as "JICA"), with regard to the recommendation made by the Indonesian and Japanese Joint Evaluation Team which conducted the evaluation survey from September 30 to October 5, 1983, had a series of discussions, through the Resident Representative of JICA in Indonesia, Mr. Hiroshi YAMAMURA with the authorities concerned of the Government of Indonesia in view of the extension of the period of the Technical Cooperation for the Mariculture Research and Development Project (hereinafter referred to as "the Project") based on the Record of the Discussions (hereinafter referred to as "R/D") which signed in Jakarta on March 31, 1982 and will be terminated on March 31, 1984.

As a result of the discussions, both sides agreed to recommend to their respective governments to carry out a follow-up cooperation and to extend the period of the technical cooperation based on the above-mentioned R/D, until March 31, 1986 in order to attain the anticipated objectives of the Project.

Jakarta, March 16, 1984



Mr. Hiroshi YAMAMURA  
Resident Representative  
Japan International  
Cooperation Agency.



Mr. Sofyan Ilyas  
Director  
Central Research Institute  
for Fisheries ( CRIF )  
Ministry of Agriculture.

THE MINUTES OF DISCUSSIONS  
CONCERNING  
THE TECHNICAL COOPERATION  
F O R  
THE MARICULTURE RESEARCH AND DEVELOPMENT PROJECT  
A T  
THE 4TH JOINT-COMMITTEE HELD ON JULY 12, 1984

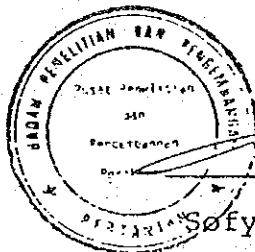
The Japanese Project Consultation Team (hereinafter referred to as "the Team"), organized by Japan International Cooperation Agency (hereinafter referred to as "JICA") and headed by Dr. Takeshi Nose, Director of Division of Fish Nutrition and Metabolism, National Research Institute of Aquaculture, Fisheries Agency, Japan, visited Indonesia from July 2, 1984 to July 16, 1984, for the purpose of working out a detailed Japan - Indonesia cooperative implementation plan (July 1984-March 1986) concerning the Mariculture Research and Development Project in the Republic of Indonesia (hereinafter referred to as "the Project")

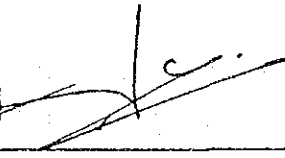
During its stay in the Republic of Indonesia, the Team exchanged views and had a series of discussions with the Indonesian authorities concerned with regard to the above-mentioned plan and the desirable measures to be taken by the Governments of both Japan and the Republic of Indonesia for further successful implementation of the Project in accordance with the Record of Discussions signed on August 30, 1978, the Record of Discussions of Extension signed on March 31, 1982 and the Record of Discussions of Extension signed on March 16, 1984.

The 4th Joint-Committee was also held during its stay in the Republic of Indonesia at the Central Research Institute for Fisheries in Jakarta in accordance with Article VII (Administration of the Project) of the Record of Discussions signed on August 30, 1978 (hereinafter referred to as "the R/D") for the purpose of formulating an working plan (July 1984 - March 1986) of the Project and dealing with specific matters connected with the implementation of the Project.

As a result of the discussions at the Joint-Committee, the Japanese and Indonesian sides, composed of such members (including those of the Japanese Consultation Team) as a participants' list attached hereto, made the following minutes of discussions which is attached hereto as Appendix.

J u l y 12, 1984



  
Sofyan Ilyas

Chairman of the 4th  
Joint - Committee  
Director,  
Central Research Institute  
for Fisheries.

WORKING PLAN OF THE MARICULTURE  
RESEARCH AND DEVELOPMENT PROJECT (ATA - 192)  
1984 - 1986

I. INTRODUCTION

As a follow up of "Record of Discussion" on Extension of the Period of the Technological Cooperation for the Mariculture Research and Development Project (ATA-192) held in Jakarta on March 16, 1984, the Japan International Cooperation Agency organized Project Consultation Team headed by Dr. Takeshi Nose, Director of Fish Nutrition and Metabolism Division, National Research Institute of Aquaculture, Fisheries Agency, Japan to visit Indonesia from July 2 to July 16, 1984, for the purpose of working out a detailed Indonesian and Japanese Cooperative implementation plan (July 1984 - March 1986) for the Mariculture Research and Development Project in Indonesia.

During their stay in Indonesia, the team visited the project site, exchanged views and had a series of discussion with the Indonesian authorities concerned with regard to the above-mentioned plan and the desirable measures to be taken by the governments of both the Republic of Indonesia and Japan for successful implementation of the Project in accordance with the Record of Discussion signed on March 16, 1984.

This Project has been implemented for five years and three months, during which time the conducted activities provided basic knowledge and technologies necessary for mariculture development in the Republic of Indonesia. As a part of the activities, the shellfish culture and environmental study had achieved the Project objectives, thus terminated March 31, 1983 and March 31, 1984 respectively, as agreed at the Joint Committee Meeting held on October 5, 1983. At present, the cooperation in the field of fish culture is still in underway and the research activities have progressed considerably due to the improved facilities and equipment especially during

the last two years. Before the termination of the second extended period, several basic knowledge and technologies as will be indicated below, have to be mastered for establishment of totally organized production system, and also for smooth management of mariculture at the project site by the Indonesian side, thereafter. For these purpose, further efforts should be made to have a better arrangement on the equipments and facilities of the Project site, especially at the Bojonegara Station, Serang, West Java.

Report of activiteis of the Project and the publication of research papers during seven years period are agreed by both sides as a matter of first priority. Publication of manuals concerning individual technologies is also mandatory for the future development of mariculture in Indonesia.

## II. RESEARCH ACTIVITIES

### 1. General Raising

More than 19 species of fish including Giant-seaperch, Rabbit fish, Snapper and Groupers have been raised mostly in floating net-cages and their feeding activity, food preference, growth rate, feed efficiency, etc., were observed and measured. These date provided valuable information on the selection of 8 species, Giant-seaperch (Lates calcarifer), Rabbit fish (Siganus canalicatus, S. guttatus, S. javus), Groupers (Epinephelus tauvina) and Snappers (Lutjanus altifrontalis, L. johni, L. argentimaculatus), as good candidate for mariculture and the efforts should be focused in the near future. It is worth to note that in those 8 species of fish, several disease problems had accured indicating the possible constraint for the expansion of mariculture. For the project accomplishment, the following research activities should be conducted.

#### a. Rearing experiments on the floating cage nets

The above mentioned 8 species be raised on several kinds of diet such as trash fish, formulated diet and moist pellets, etc.

b. Rearing experiments on the sea-water ponds and on pen culture

Experiments of rearing fry of the 3 species of rabbit fish be done in sea-water ponds. Experiments using fish pens with or without supplemental diets or fertilizer will be conducted. These experiments will provide background data for possibility of extensive way for mariculture.

c. Protection against parasites and diseases

Several parasites and diseases have been observed in the cages and tanks during the past research experiments. However, only few knowledge has been accumulated on the taxonomy of these parasites. Thus, parasitological background knowledge is absolutely needed to reduce the constraints for further development of research works on general raising. Therefore, it is considered that Japanese short term expert for parasitology be dispatched for survey of parasites at the Project site. Indonesian counterpart who has sufficient basic knowledge on bacteriology and/or virology on fish disease will be expected to study high technology of fish disease research in Japan.

2. Breeding of Spawner

Stocking of spawner in cage nets and tanks is essential to obtain fertilized eggs. As mentioned above, 8 species are carefully reared in the raising experiments and some possibilities exist at fairly high percentage that the reared fish become spawners within the two years. In addition, the Project has conducted continuous surveys to collect the wild spawners. For the establishment of broodstock technique, the following two experiments should be conducted.

a. Collection of Natural Immature Fish

Spawners of giant seaperch and snappers have been available from the estuary of river Sekampung, Lampung and coastal area of West part of Java. Further study is recommended to do survey on the natural distribution of spawners as a partial effort for verification trials.

b. Raising of Spawners



Three species of rabbit fish have been able to get mature in net cage and tank. Also giant seaperch could possibly be matured, if they were raised in a large net cage or a tank of large volume. A trial of testosteron injection is worth to be done for the observation of sex-change that commonly occurs in grouper.

### 3. Fry Production

#### a. Collection of Natural Fry

Fry collection experiment had been intensively conducted by the project in Banten Bay and other locations for the past five years, and a lot of information such as their species distribution, and seasonal fluctuation, were already obtained. However, their economical value as seeds for fish culture has not been well investigated. Therefore, the continuous fry collection of the wild fish might be important as support of the verification trial.

#### b. Culture of food organisms

Experiments of food culture organisms had been conducted in many ways in the past five years. The technique has been well transferred to the Indonesian scientists. However, it is still necessary for counterparts to develop technique for mass culture of the food organisms such as rotifers and Chlorella, preparing for mass production of fry.

#### c. Induced Spawning

Artificial fertilization of the eggs of rabbit fish was conducted successfully by stripping method with hormonal injection. In addition, the fishes treated with hormone (gonatropin) spawned in the tank. Some trials of induced spawning with another hormone, i.e., pituitary organs of salmonid and chinese carps have been proved as an effective treatment and might be applied to other species.

#### d. Natural Spawning in cage net and tank

It appears that the successful mass fry production has a close relationship with the development of the systematic and

intentional method for natural spawning in tanks. In this Project, success has been achieved for the spawning of rabbit fish in tanks. Continuous experiment of natural spawning is useful for further verification and extension of natural spawning technique.

#### e. Larval Rearing

Small-scale larval rearing has already been conducted for several species. In addition, larvae of giant-seaperch were transferred successfully from Thailand, and they were reared with high survival rate. But, mass rearing of larvae have not been achieved by the Project. Therefore, such a trial should be conducted on both artificial and wild larvae with mass culture of food organisms to demonstrate principle of mass fry production.

#### 4. Feeding Experiment

Concerning the feeding experiment, small number of experiments has been conducted so far. As the feeding experiment is a basic for the development of diet, establishment of feeding conditions etc., then, short term experiments should be carried out. The proposed experiments comprises two following items:

a. Search and investigation of diets or economical diets to substitute for raw fish diet and commercially formulated feeds

For rabbit fish culture, commercial feeds for carp has been used conventionally. More adequate and reasonable diet should be prepared for rabbit fish and others. However, precise rearing system and equipments for chemical analysis to investigate nutritional requirement are not well provided. Therefore, short time rearing experiments with various diet might be effective for the acquirement of how to design an adequate diet for each species in the developmental stage of the life cycle.

b. Investigation of feeding ecology

Feeding ecology is different among species and in their developmental stage. It is important to investigate such ecology for preparation of most reasonable feeding manual for each species, especially if we consider the economical point of view.

#### 5. Field Verification Trials (in collaboration with Sea Farming Development Center, Directorate General of Fisheries)

Prior to the adoption of technologies/generated by the Project, set up of verification trials would be desired as a step for further extension.

Verification trials should be conducted closely with SFDC of DGF. Further detail operational plan including for the cost benefit analysis will be made by the Project and SFDC of DGF.

Advice on experimental fish such as those being raised in the cage net at the Project site could be provided, if these are requested.

#### 6. P u b l i c a t i o n s

Before the termination of the project, a final report of the activities and the results of research works and experiments will be published. Presentation of draft papers are mandatory for each expert and counterpart on the items they had responsibility for the performance at the time of edition for publication. Also the manuals for each of culture technologies must be published before the end of the Project. The manuals should be published both in Indonesian and in English. The Indonesian side is responsible for editing the Indonesian version. Final report will be presented to both Governments and will be made prior to termination of the Project.

WORKING SCHEDULE (1984/1986)

Items	1984			1985			1986			
	Month	4	5	6	7	8	9	10	11	12
1. General Raising										
a. Rearing experiments on the floating cage nets										
b. Rearing experiments on the sea-water ponds and on pen culture										
c. Protection against parasites and diseases										
2. Breeding of Spawner										
a. Collection of natural immature fish										
b. Raising of spawners										
3. Fry Production										
a. Collection of natural fry										
b. Culture of food organisms										
c. Induced Spawning										
d. Natural spawning in cage net and tank										
e. Larval rearing										
4. Feeding Experiment										
a. Search and investigation of economical diets										
b. Investigation of feeding ecology										
5. Field Verification Trials										
6. Publications										

\* Manuals & Research Reports


THE JOINT EVALUATION REPORT  
ON  
MARICULTURE RESEARCH AND DEVELOPMENT PROJECT (ATA-192)

Leaving two months till the termination of cooperation period on March 31, 1986 as stated in the Record of Discussion of Extension of the Period of the Technical Cooperation for the Mariculture Research and Development Project ( hereinafter referred to as "the Extended R/D" ), the Joint Evaluation Team ( hereinafter referred to as "the Team" ) was organized for the purpose of reviewing the achievement of the Project within extended period giving recommendation for completion of the cooperation.

The Team, which consisted of the Indonesian team headed by Mr. Sofyan Ilyas, Director of Central Research Institute for Fisheries, Agency for Agricultural Research and Development, Ministry of Agriculture and the Japanese team headed by Dr. Takeshi Nose. Leader of Japanese Evaluation Team organized by Japan International Cooperation Agency, conducted an evaluation of the Project from January 13 to January 16, 1986.

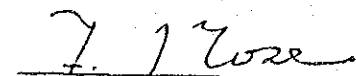
After visiting the Project site and conduction of a series of discussion with authorities and experts concerned, the Final Joint Evaluation Meeting was held in Jakarta on January 16, 1986.

As a result of the meeting the Team presented its evaluation report to the 5th Joint Committee Meeting. We agree to recommend to both Government through their respective agencies for termination of the Project on March 31, 1986.



Sofyan Ilyas  
Director,  
Central Research Institute  
for Fisheries

Jakarta, January 16, 1986



Takeshi Nose  
Leader of the Japanese  
Evaluation Team for the  
Project

## I. INTRODUCTION

In view of developing mariculture in Indonesia, this Project started seven years and four months ago, based on the "Record of Discussion " signed on August 30, 1978. As a result of the first joint evaluation, an extension of the project for another two years up to March 31, 1984 was recommended and the "Record of Discussion of Extension" was signed on March 31, 1982. Thereafter, the cooperation in the field of shellfish culture was finalized successfully on March 31, 1983, being the cooperation in the field of finfish culture continued.

In October 1983, the second joint evaluation was conducted with resulting recommendation to extend the project for additional two years up to March 31, 1986 and the "Extended R/D" was signed on March 16, 1984. In order to overview the results and to evaluate the execution of the Indonesian and Japanese Cooperation Implementation Plan for the Mariculture Research and Development Project in Serang, and to make any recommendation to both Governments through their respective agencies, the Project Evaluation Team being organized by the Japan International Cooperation Agency visited Indonesia from January 8 to January 22, 1986.

During their stay in Indonesia, the team visited the project site, exchanged information on the execution and results of the Project, and had series of discussion with the authorities concerned with regard to above mentioned plan with focus on the results and impacts of the Project as well as the desirable measures to be taken by the government of the Republic of Indonesia after the termination of this Project.

This project has been implemented for seven years and five months, during these periods the conducted activities have provided successfully the basic knowledge and technologies necessary for the development of mariculture which was at the initiating stage when the Project was started in Indonesia.

As a part of the activities, the shellfish culture and environmental study had achieved the Project objectives successfully and terminated on March of 1983 and 1984 respectively, as agreed at the Joint Committee Meeting held on October, 1983. For the cooperation in the field of fish culture, the research activities have progressed remarkably due to the improved facilities and equipments especially in the last two years. Several basic knowledges and technologies, indicated below, have already been mastered for establishment of totally organized production system, and also for smooth management of mariculture at the project site. Published research reports and extension manuals concerning individual technologies generated by the Project are considered to be of great use by both sides for further development of mariculture in Indonesia.

The project is now coming to its final goal with fruitful results, giving considerable impacts for the future development of Indonesian mariculture. After the termination of the Project, the Indonesian counterparts is suggested to be able to lead research works on other parts of the country and will contribute to the future development of mariculture in Indonesia. In this connection, further efforts should be made to have a better arrangement on the equipments and facilities at the Bojonegara Station, Serang, West Java, and maintenance of research activity at the Station at high level are strongly requested by both sides.

## B. Evaluation

### 1. Method

Criteria to evaluate the results of activities by the Project were defined as follows :

- A. Experiment can be conducted by Indonesian side
- B. Indonesian counterparts can conduct experiments by advice and under the guidance of Japanese experts.
- C. There are still need to dispatch Japanese experts in order to achieve the aim of research.

### 2. Over - All evaluation

#### 1. General raising

- 1) Rearing experiments by floating cage nets. A
- 2) Rearing experiments by sea water ponds and pen culture A
- 3) Protection against parasites and diseases. B

#### 2. Breeding of spawners (Broodstock).

- 1) Collection of natural immature fish. A
- 2) Raising of spawners. A

#### 3. Fry production.

- 1) Collection of natural fry. A
- 2) Culture of food organisms. A
- 3) Induced spawning. A
- 4) Natural spawning in cage nets and tanks. B
- 5) Larval rearing. A

#### 4. Feeding experiments. A

#### 5. Field verification trails (in collaboration with the Sea Farming Development Center, Directorate General of Fisheries). A

#### 6. publications A\*

\* Papers under preparations should be published till termination of the Project.







JICA