

インドネシア浅海養殖開発計画 エバリュエーションチーム報告書

昭和59年4月

国際協力事業団

インドネシア浅海養殖開発計画 エバリュエーションチーム報告書

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昭和59年4月

国際協力事業団

国際協力事業団	
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は し が き

本プロジェクトは、ジャワ島西部のセランに於て魚貝類の養殖技術を研究開発することを目的として、昭和53年8月に3年8ヶ月の協力期間をもって開始された。その後2年間の期間延長が行われ、昭和59年3月に協力期間が終了する。

延長後の協力期間が終了するに当り、本プロジェクトの成果を評価し、かつ今後の協力の対応について検討を行うため、国際協力事業団は、昭和58年9月に水産庁養殖研究所栄養代謝部長能勢健嗣氏を団長とするエバリュエーションチームを派遣し、インドネシア関係各機関と共同して評価を実施した。

本報告書は、この評価の結果をとりまとめたものである。

最後に、本調査の実施に際して協力を賜ったインドネシア政府、現地日本大使館、外務省及び農林水産省の関係各位に対し深甚なる謝意を表する次第である。

昭和59年1月

国際協力事業団
理事 松山良三

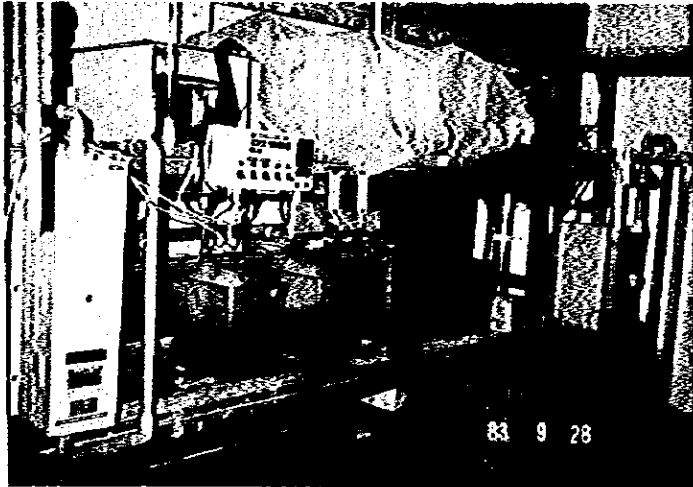


カウンターパートへの技術者指導
(カラガツツ・ステーション)

フローティング・ネットケージでの養成試験
(ボジョネガラ・ステーション沖合)



カラガツツ・ステーションの
Wet, Lab.



カラガツ・ステーション
Wet, Lab. 内の餌料生物
培養設備



グリーンウォーター
(クロレラ)の培養
(カラガツ・ステーション)



素掘り海水池
(カラガツ・ステーション)



合同評価委員会準備のためカウンターパート専門家との打ち合せ

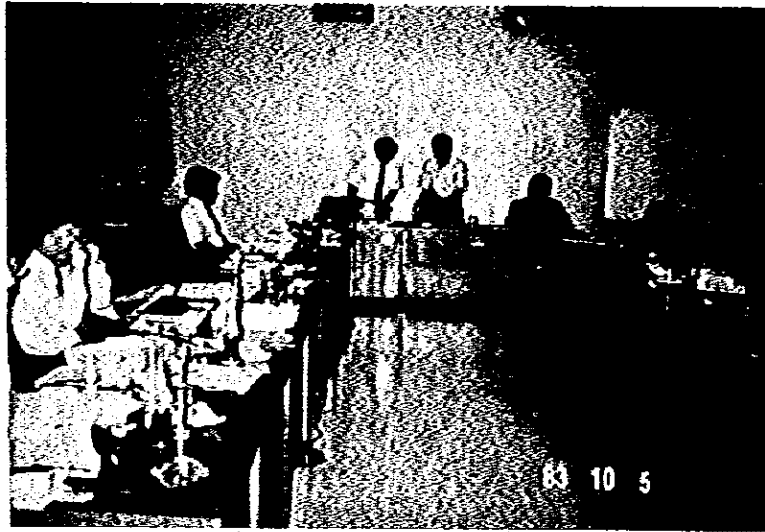


前列左より 技専門家、田中専門家、
 濱田団員、WARDANAアンチョール研究
 所長、FATUCHRIカラガンツ試験所
 所長、後列左3番目より吉光リーダー、
 能勢団長、SADIKIN長官、山村JICA
 ジャカルタ事務所長、PURWITO海洋漁
 業研究所所長、SOFYAN中央漁業研
 究所所長、吉元JICA事務所員

サデキン農業研究開発庁長官公邸への表敬



合同評価準備委員会(83年10月3日、中央漁業研究所)



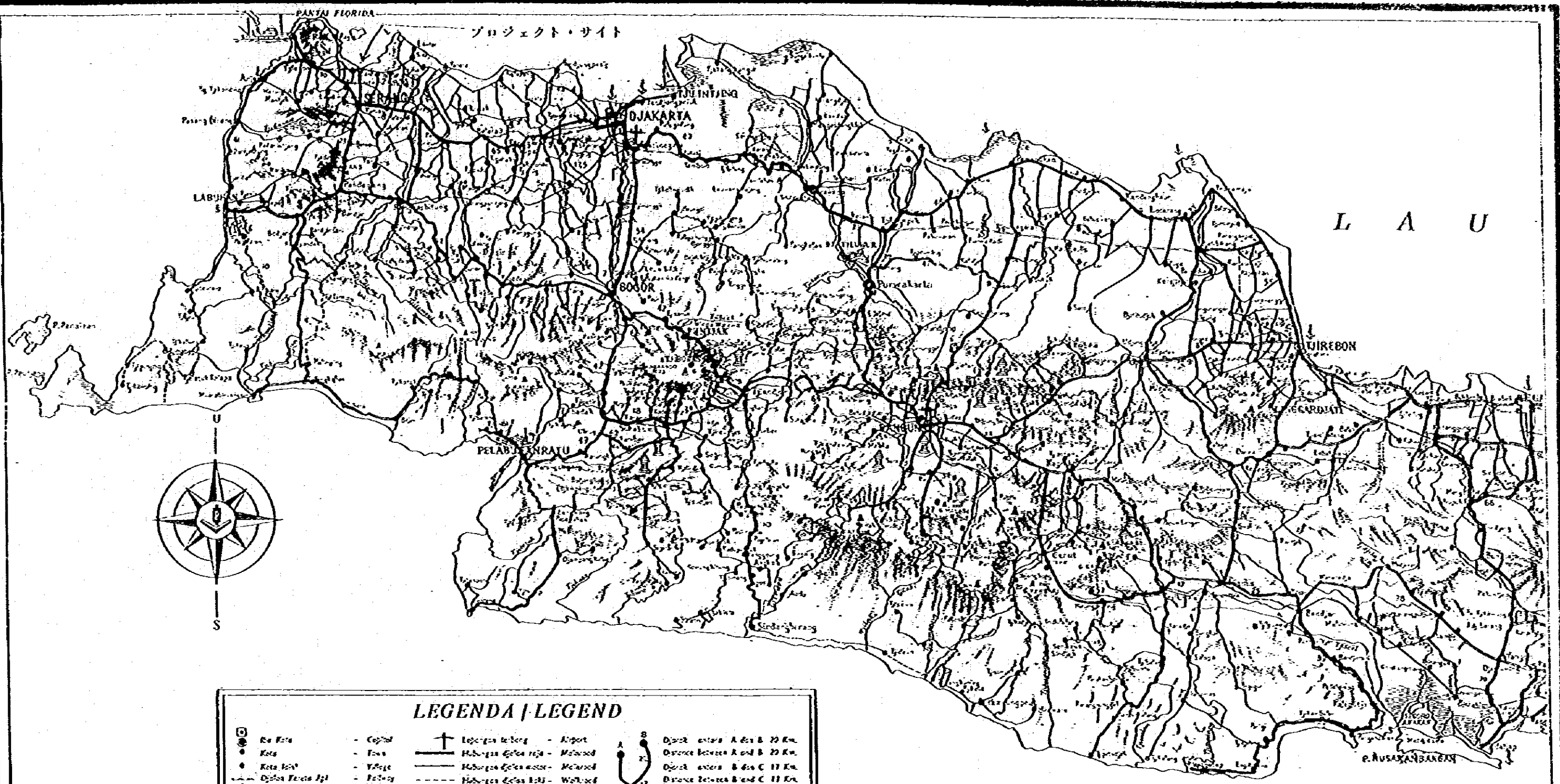
最終合同評価委員会（10月5日，中央漁業研究所）



（左より 能勢団長，議長Dr. PURWITO，イ側エバチーム代表Mr SOFYAN）



日・イ エバチーム代表者による合同評価委員会報告書署名



LEGENDA | LEGEND

	Kota Kota	- Capital		Tempat terbang	- Airport		Jarak antara A dan B 20 Km.
	Kota	- Town		Jalan raya	- Highway		Jarak antara A dan B 10 Km.
	Kota kecil	- Village		Jalan desa	- Village road		Jarak antara B dan C 11 Km.
	Diponegoro Ipi	- Ferry		Jalan desa kecil	- Small village road		Jarak antara B dan C 11 Km.
	Tempat suci	- Temple		Gunung	- Mountain		Jarak antara A dan C 11 Km.
	Perkebunan	- Rubber		Danau	- Lake		Jarak antara A dan C 11 Km.

Diperbarui oleh: PUSP & BROSNO
Kediri: DR. CHORO LITZ

PENERBIT PÉMBINA
PUBLISHER

S A M U D E R A I N D

1970/1971

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写 真
地 図

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1. 調査報告要約

インドネシア浅海養殖プロジェクトは、昭和56年11月に派遣されたエバリュエーションチームのプロジェクト評価をふまえ、魚類養殖については、57年4月1日から2カ年間、貝類養殖については1カ年間の期間延長がなされた。その後、57年8月に派遣された計画打合せチームとインドネシア側との間で延長後の残余協力期間内における養殖試験・研究にかかる実施計画について協議され、日・伊合同委員会において承認された。

今回エバリュエーションチームは、59年3月の協力期間終了を前にして、日・伊合同評価委員会を開催し、延長後のプロジェクトの実施状況について評価を行い、併せて今後のプロジェクトへの対処方針について協議することを目的として派遣された。

その結果、別記のとおり評価がなされ、日・伊合同評価委員会において承認された。併せて今後のプロジェクトに協力についての要望が提出され、詳細な合同評価報告書が作成された。その概要は下記のとおりである。

インドネシア浅海養殖プロジェクトエバリュエーション報告概要

〔プロジェクトの概要〕

魚貝類の養殖技術の開発研究を行うことを目的とし、当初その協力期間はS 53. 8. 30からS 57. 3. 31までであったが、エバリュエーションの結果をふまえ、延長R/DによりS 59. 3. 31までの2年間延長され、現在実施中である。

〔プロジェクトの現状〕

貝類養殖分野については、技術移転は完了し、ミドリイガイの養殖技術マニュアルが作成された。(S 58. 3. 31 協力終了)

魚類養殖分野は施設整備がほぼ完了し、本格的な試験研究を実施中である。基礎技術・知識については、かなりよく技術移転が行われ、またより高度な技術についても部分的にカウンターパートに移転されている。

〔今後のプロジェクト協力について〕

これまでに得られた技術・知見を体系化し、トータルシステムとしての養殖技術を確立する必要がある。そのためには伊側が主体となって専門家の指導・助言のもとに試験研究を進めていくべきであり、フォローアップとして協力することが必要である。

Ⅱ. プロジェクトの経緯

- (1) インドネシア国政府は、ジャワ島において魚貝類の養殖技術を開発し、もって沿岸零細漁民の所得向上、雇用促進、漁獲量の増加を図り、最終的にはジャワ本島に食用動物性蛋白の供給を目的とした浅海養殖事業を計画しているところ、我が国に対し、養殖技術の確立とその技術移転にかかる協力を要請してきた。
- (2) 当事業団は、昭和50年及び51年の2回にわたり予備調査を行い、更に昭和52年に2名の長期調査員を派遣して、その可能性等について調査を行ってきた。
- (3) 更に、本件協力実施にかかる具体的諸事項をイ国政府と協議するため、昭和53年8月15日から21日間にわたり、計画打合せチームを派遣して、我が国による今後の本プロジェクトに対する技術協力の方法に関する討議議事録(Record of Discussions, R/D)を作成した。
- (4) その後、昭和56年11月4日から11月18日まで水産庁養殖研究所企画連絡室長篠岡久氏を団長とするエバリュエーション・チームが派遣され、プロジェクト開始以来達成された成果について評価を行った。その結果、過去2年9カ月間の実施期間中、目標達成に必要な基盤がほぼ確立され、更に魚貝類養殖の基礎技術については十分指導されてきたと評価されたものの、同チームの勧告を踏まえて、魚類養殖については2カ年間、貝類については1カ年間、協力期間が延長されることとなった。
- (5) 延長後の協力期間における養殖試験・研究にかかる実施計画を策定すべく、昭和57年8月26日から9月10日まで水産庁養殖研究所栄養代謝部長 能勢健嗣を団長とする計画打合せチームが派遣された。そこでなされた準備協議をふまえ日・イ合同委員会において実施計画が承認された。現在、所期の目的を達成すべく魚類養殖研究及びカウンターパートへの技術移転が実施されているところである。

Ⅲ. 調査団派遣の目的

本エバリュエーションチームの主要目的については以下のとおりである。

- (1) 昭和57年9月の日・イ合同委員会で承認された2年間の延長期間にかかる実施計画に対する達成度を調査する。
- (2) 日・イ合同評価委員会で上記(1)につき双方確認する。
- (3) 同委員会で、昭和56年11月のエバリュエーションの評価をふまえ、今後の対処方針について併せて協議する。

Ⅳ. 調査団の編成

		分 野	氏 名	所 属
①	団長	総 括	能 勢 健 嗣	水産庁養殖研究所栄養代謝部長
②	団員	魚類養殖	濱 田 研 一	水産庁海洋漁業部国際課係長
③	団員	業務調整	草 間 政 幸	国際協力事業団林業水産開発協力部 水産業技術協力室職員

V. 調査団の日程

派遣期間 昭和58年9月25日から10月7日(13日間)

日順	月/日	曜日	行 程	内 容
1	9月25日	日	東京 → ジャカルタ CX501,711	
2	26日	月		<ul style="list-style-type: none"> ・ JICA ジャカルタ事務所及び大使館表敬打ち合せ (8:30~) ・ 農業省海外協力局長表敬・一般的意見交換 (10:30~) ・ 専門家と調査方法・日程等について打ち合せ
3	27日	火	ジャカルタ → セラン	<ul style="list-style-type: none"> ・ 水産総局局長表敬・一般的意見交換 (8:30~)
4	28日	水		<ul style="list-style-type: none"> ・ カラガンツ漁業研究所, ボジョネガラ・ラボ施設見学 (8:00~12:00) ・ カラガンツ漁業研究所において専門家, カウンターパートとの研究進捗状況等についての打ち合せ (13:00~17:00)
5	29日	木		<ul style="list-style-type: none"> ・ カラガンツ漁業研究所において, 専門家カウンターパートとの研究計画の進捗状況等について調査及び打ち合せ (8:00~17:00)
6	30日	金	セラン → ジャカルタ	<ul style="list-style-type: none"> ・ カラガンツ漁業研究所において, 合同評価委員会資料作成 (8:00~14:30)
7	10月1日	土	ジャカルタ ⇄ ボゴール	<ul style="list-style-type: none"> ・ 合同評価委員会資料作成 (8:00~12:00) ・ 中央漁業研究所所長表敬及びイ側関係者と意見交換 (13:00~15:00) ・ サデキン長官表敬夕食会
8	2日	日		<ul style="list-style-type: none"> ・ 合同委員会にかかる資料作成等の下準備

日順	月 / 日	曜日	行 程	内 容
9	10月3日	月		<ul style="list-style-type: none"> ・合同評価準備委員会（於 中央漁業研究所, 9:00～17:30）及び専門家による研究発表 ・イ樹関係者と懇親会
10	4日	火		<ul style="list-style-type: none"> ・第1回合同評価委員会（於 JICA ジャカルタ事務所9:00～17:30） ・合同評価委員会にかかる最終事前打ち合せ（18:00～19:30）
11	5日	水		<ul style="list-style-type: none"> ・第2回合同評価委員会（於 中央漁業研究所 10:00～17:00）。報告書とりまとめ
12	6日	木	ジャカルタ	<ul style="list-style-type: none"> ・ JICA ジャカルタ事務所, 大使館表敬及び現地調査報告
13	7日	金	GA-888 東京	

V. 主要面会者リスト

I Indonesian Side

1. Abdul Rahman, Director General of Fishery, Ministry of Agriculture
2. Sadikin, Director General, Agency for Agricultural Research and Development, Ministry of Agriculture
3. Siswants Siwoputra, Director General, Bureau of Foreign Cooperation.
4. Sofyan Ilyas, Director of Central Research Institute for Fisheries (CRIF)
5. Purwito Martosubroto, Director of Research Institute for Marine Fisheries - Jakarta (RIMF-Jakarta)
6. Alie Purnomo, Director of Research Institute for Fisheries - Maros
7. Wardana Ismail, Co-Project Manager ATA-192 Anchor Marie Fisheries Research Laboratory
8. M. Fatuchri, Chief of Serang Marine Fisheries Research Laboratory
9. Tatan Sujastani, Chief of Planning Div., CRIF
10. A. Dwiponggo, Staff of RIMF-Jakarta
11. Subhat Nurhakim, Staff of RIMF-Jakarta

II Japanese Side

1. S. Kadoya, First Secretary, Embassy of Japan.
2. H. Yamamura, Representative of Jakarta Office, Japan International Cooperation Agency (JICA)
3. K. Yoshimoto, Staff in charge of the Project, JICA Jakarta Office
4. T. Yoshimitsu, Project Leader, Mariculture Research and Development Project (MRDP)
5. H. Tanaka, Fish Culture Expert, MRDP
6. H. Eda, Fish Culture Expert, MRDP
7. T. Kurihara, Coordinator, MRDP

Ⅶ. 調 査 結 果

エバリュエーションチームが訪伊期間中、10月3日中央漁業研究所において合同評価準備委員会が、10月4日・5日の両日それぞれ JICA ジャカルタ事務所及び中央漁業研究所において合同評価委員会が開かれた。同評価委員会の討議の結果、巻末（資料）のとおり合同評価報告書が作成された。合同評価報告書の目次は以下のとおりである。

1. 序 文

2. 評価の目的

3. 評価の方法

4. 評価の結果

4.1 調査研究実績評価

4.2 日本側によって実施された協力内容

4.3 インドネシア側によって実施された協力内容

5. 要望事項

(付 録)

1. 合同評価委員会出席者

2. 第3回合同委員会議事録

3. 調査研究実績評価表

4. 研究施設整備状況

5. 日本人専門家の派遣、機材供与、日本でのインドネシア研究者の研修

6. プロジェクト協力において今後実施されるべき研究事項

(付属文書)

・2年間の延長期間に実施された協力活動の要約

1. 日本側の協力実績

1. 日本人専門家派遣

2. 機材供与

3. 研修員の受け入れ

4. 施設・設備の建設

II. 研究結果（1982年4月から1983年9月まで）

1. 養殖池の環境調査
2. 貝類養殖
3. 魚類養殖

III. 魚類養殖研究データ

以下本章においては合同評価報告書に即して調査の結果をとりまとめる。

1. 評価結果

合同評価チームは、本プロジェクトの調査研究はかなりの程度まで進捗しており、魚類養殖において十分でない分野があるものの本格的な試験研究がなされていると評価した。評価結果は付表に示されるとおりである。

(付表)

評 価 表

1. 海面養殖場の環境調査	
1.1 定期定点観測	A
1.2 プランクトンの季節変動	A
1.3 底質分析	B
2. 貝類養殖	
2.1 二枚貝の天然採苗試験	A
2.2 養殖技術開発	
a. ミドリイガイ	A
b. アカガイ	A
c. カキ	A
2.3 人工種苗生産	
a. 餌料培養試験	A
b. 種苗生産試験（生物学的基礎知見の集積を目的とする）	A
3. 魚類養殖	
3.1 養成試験	
a. 小割生簀による養成試験	A
b. 池中養成試験	B
c. 病害防除試験	C
3.2 親魚養成	
a. 天然未成熟魚の採集	B
b. 親魚養成試験	B
3.3 種苗生産	
a. 天然種苗の採集	A
b. 餌料生物の培養試験	B
c. 人工採卵試験	B
d. 小割生簀および陸上水槽内の自然産卵試験	B
e. 稚仔魚の飼育試験	C
3.4 餌飼生態	B

4. 機材の維持管理および取り扱い

B

評価基準

- A：インドネシア側だけで試験研究を実施できる。
- B：専門家の指導助言のもとでカウンターパートが試験研究を実施できる。
- C：目標に達しておらず専門家の派遣が必要である。

2. 調査研究及び技術開発の実績

延長期間内で、施設・設備が建設・整備されており、現在のところ後に述べるように施設の整備及び機材の修理が若干必要であるも、プロジェクトの所期の目的を達成すべく、施設・設備の基盤はほぼ整備されたといえる。

これらの基本的な研究施設の整備・改善はプロジェクトの活動を大幅に活性化した。

基礎的技術・知識の蓄積において顕著な進歩がみられたのみならず、餌料生物の培養、人工産卵誘発、稚仔魚の飼育などの広範な分野においても有用な技術の移転がおこなわれた。

本プロジェクトは海面養殖のより高度な基礎的技術を、バンテン湾およびインドネシアの沿岸域に普及させる前段階のひとつのモデルとして実施されているので、施設・設備の機能が十分に発揮され稼働できる状態で、かつ機能的に組織された研究者による責任ある実施体制のもとでの技術移転が期待されている。

現行プロジェクトは、その協力期間が終了に近づきつつあるが、魚類養殖分野においては、まだ研究課題が残されており、知識の蓄積、技術の移転、技術の開発および知識の確立が必要である。

集約的な魚類養殖に対する制限要因を解消すべく実施された各分野における研究評価の要約を以下に述べる。

2-1 海面増養殖場の環境調査

定点観測は、プランクトンの季節変動及び生息環境調査について継続され有用な情報を蓄積している。しかしながら底質と水質の分析技術については、カウンターパートがさらに習熟する必要がある。

2-2 貝類養殖

採苗から収穫までの一貫した実用的な養殖技術は企業化できる段階まで確立された。これまでに獲得された実用的な知識及び技術はカキ養殖・アカ貝等他の有望種に対してもインドネシア側によって応用されることが望ましい。

2-3 魚類養殖

網生簀では、有用養殖魚種の開発のために、19種の魚が研究されている。幼稚仔魚・未成魚及

び成魚の分布調査についても継続されている。

新しく建設されたウェット・ラボにより、基礎知識・技術はかなりの程度までインドネシア側に蓄積され、移転されている。特に人工産卵、種苗生産、生物餌料培養については、既にインドネシア側に移転されている。

餌料の組成と配合、病害防除については早急に対応すべき問題である。

仕切り養殖や池中養殖等の粗放的な魚類養殖も研究が促進されるべきである。

2-4 機材・設備の維持管理

基本的な機材及び設備は、おおよそ保持されているが、修理技術の欠如あるいは修理予算の支出の遅れから故障したままのものもある。

設備・機器は、試験研究に差し支えないよういつでも良好作動可能な状態であるよう管理すべきである。

3. 日本側の協力実績

3-1 専門家派遣

長期専門家として3名の研究者と1名の業務調整員が派遣され、短期専門家として5名の研究者が派遣された。

それぞれの専門家は、計画に従い適切に派遣され、かつプロジェクトの実施に関して所期の目的を果たした。

3-2 研修員の受け入れ

個別研修のため、海面増養殖に関する学習及び研究のために個別研修員として2名が受け入れられた。各カウンターパートは、新しい知識と技術を獲得し、帰国後試験研究の遂行にその成果が生かされるものと期待される。

3-3 機材の供与

研究用機材、環境調査用機材、養殖用機材、車輻ボートエンジン交換部品等 8600 万円 (1983 年度予算による機材供与を含む)

3-4 その他

応急対策費 1,668,000 円によって取水施設が整備された。

4. インドネシア側の協力実績

4-1 カウンターパートの配置

インドネシア側は第3回合同委員会での年回実行計画及び日本側からの申し入れ事項に基づき、日本人専門家に対し7人のカウンターパートを配置した。

4-2 施設・設備の整備

倉庫、ウェット・ラボ、30tタンク2基等研究施設が整備された。(資料IのAnnex 4参照)カラガンツ試験場及びボジョネガラ試験場ともその機能を向上させるためにより一層の努力が必要である。

4-3 プロジェクトの予算

プロジェクトの最大の問題は、施設の建設、人材不足などであり、これらは予算の効果的な支出に問題があるために生じている。

これらの問題を解決すべく努力されてきているが、今なおさらに会計事務の迅速化が望まれるところである。

これまで過去2年間に総額387,000,000ルピアがプロジェクトにかかる経費として支出された。

4-4 その他

補足的な措置としては養殖試験研究の管理運営の一部として、魚類の養成実験に対する責任管理体制の強化が必要とされる。

5. 要望事項

合同評価委員会では下記につき日・イ両政府関係機関を通じ両国政府に対し要請することで合意した。

プロジェクト協力は、1984年3月31日終了となっている。しかしながら、第3回合同委員会で策定された年間計画の目的および背景を考慮し、かつ研究項目の目的を達成するとともに、パイロット規模での養殖プロジェクトを開始するに先だちこれまでに蓄積された魚類養殖に関する全ての情報と知識を体系化するために、両国政府に対し、本プロジェクト延長R/Dにうたわれている現行の協力期間終了後、期間をもう2年間延長するよう関係機関を通じ要請する。

第2次延長期間内では、資料II、Annex 6の項目につき研究開発を行うため資料II、Annex 5の協力を要請する。

また漁業者や養殖家への情報の提供源として、本プロジェクトの研究結果及びマニュアルを作成し発行することが強く望まれている。

資料 I 試験研究結果 (1982年4月から1983年9月まで)

1. 海面増養殖場の環境調査

第三回合同委員会(1982年9月7日開催)で討議され設定された計画に従って、バンテン湾の調査が実施された。

1.1 定期定点観測

定点観測は継続され、その結果は1982年にレポートとして報告されたが、それによればバンテン湾の環境は海面増養殖場として適当である。観測は1983年も継続され、その結果はカウンターパートによって本プロジェクト協力期間終了までに報告書としてとりまとめられることになっている。

観測技術マニュアルについてもインドネシア側によってとりまとめられることになっている。

1.2 プランクトンの変動

バンテン湾でのプランクトンの分布と変動についての調査概要は、1980年/1981年分はとりまとめられた。その後の調査結果については、カウンターパートによってまとめられることになっている。

1.3 底質分析

バンテン湾の東側には砂泥地域がみられ、他の地域とは異っているが、貝の生息場所としては適当である。この地域は雨期には範囲が狭まり、季節変動する。重金属の分布調査についても、国立海洋研究所(アンチョールに所在する)によって実施された。

注:

バンテン湾の環境条件は延長期間内でその概要が明らかにされ、それにかかる基礎知識および観測技術は、インドネシア側へ適切に移転された。しかし、特に化学分析技術の修得についてはカウンターパートのより一層の努力が必要であるし、また調査用機器の維持管理についても、常に使用可能な状態にあるよう十分配慮されるべきである。

2. 貝類養殖

一年間の延長期間内において、ミドリイガイの一貫した生産システムに必要な基礎技術は、インドネシア側へ適切に移転された。パイロットファームからの収穫はその技術の確立を実証し、水産総局長らの出席を得て、盛大な収穫祭が催された。また高度な技術である人工産卵誘発技術も導入された。

2.1 二枚貝の天然採苗試験

1982年にこの分野に関する新しい知見、重要な知見を取り入れた報告書が作成された。貝類養殖分野協力期間終了後もカウンターパートによって試験が継続されているが、採苗を大規模に行うためには、より一層の努力が必要である。

2.2 養殖技術開発

2.2.1 ミドリイガイ

(a) 中規模養成試験

基礎技術の開発は成功し、パイロットフローティングファームでは、養成試験は成功し、1982年11月に前述の収穫祭が催された。バンテン湾でのミドリイガイの養殖マニュアルは作成されたが、カウンターパートによる大規模採苗試験は1983年度では十分な成果が得られなかった。

(b) 一貫した生産体系の検討

基本的には一貫した生産体系は確立されたと言えるが、一貫した生産体系を改良・普及および安定化させるべく研究はインドネシア側によって実施されるべきである。

2.2.2 アカガイ

有用種の選定に関する基礎研究は実施されたが、バンテン湾の底質で試みた採苗器の流出事故によって十分な知見は得られなかった。バンテン湾周辺の固有種の分類については堀越教授（東京大学）によって研究された。

2.2.3 カキ

日本から移殖したマガキ (*C. gigas*) と現地産カキの養殖試験が実施された。現地産カキおよび日本から移殖したカキとの比較試験の結果、養殖には現地産カキ (*C. iradelei*) が有望種であることが明らかとなった。日本産カキについては、バンテン湾ではその完全なライフサイクルを維持し得ないが、移殖後の一年間は著しい成長を示すことが確認された。したがって日本産カキを養殖する場合、採苗のための人工産卵誘発および種苗養成に関する高度な技術の導入が養殖成功のための鍵となる。

バンテン湾でのカキの採苗試験は沿岸漁業者の漁撈活動により漁場が荒廃したため中止し、代わりに panimbang で二月に一度の割合で実施されたが、種苗は大量には収集できなかった。

2.3 人工種苗生産

この分野では3編の報告書が提出された。二枚貝の養殖ハンドブック（英語版）も作成された。1983年3月にはボジョネガラ試験場にウェット・ラボの建物が建設され、餌料生物培養のための恒温室、人工産卵誘発のためのシステム、種苗養成水槽などの設備が9月までに設置された。これらの設備は、カウンターパートがその操作技術を修得するならば、人工種苗生産技術の開発にとってその機能を十分に発揮することが期待される。

幼生の初期餌料として、日本から数種類のケイ藻が導入され、前述のウェット・ラボの餌料生物培養室で培養されている。

3. 魚類養殖

3.1 親魚養成

アカメ、アイゴ類、ハタ類を含む19種以上魚種が主に網生簀で養成された。摂餌生態、各種飼餌料の栄養価組成、成長率、餌料効率等について観察され、記録された(資料Ⅱ, Table 1 参照)。これらのデータから近い将来、海面養殖魚種として普及されるべき有用種を選定する際に貴重な情報を得ることができる。またこれまで発生した病害について記載することは、今後海面養殖を進展させるうえで障害となり得る可能性を示唆するという意味において重要である。

3.1.1 小割式生簀による養成試験

生簀魚、配合飼料やモイスベレットなどの各種餌料により次の魚種の飼育実験が長期間にわたり行われた。アイゴ類：5種、アカメ、ハタ類：5種、フエダイ類：5種、他の魚種：3種(資料Ⅱ, Table 2 と 3 参照)

(a) アイゴ類

アイゴ類では成長率の低いものが多く、一年間の飼育で体重 300 g を越えるものはまれである。それに加えて、飼育実験期間中に大量の斃死が発生し、その結果、生残率はかなり低くなった。これまでのところ斃死の原因は解明されていない。魚類養殖が確立する以前にこれら制限要因が解明されるべきである。この種は粗放養殖適種として選定される可能性がある。

(b) アカメ

アカメは著しい成長率と生残率を示した。病害問題はほとんど見いだされなかった。

(c) ハタ類

ハタ類のうち数種のもは著しい成長率を示したので、実験の対象範囲を広げ他のハタ類についても研究を継続すべきである。生残率についてもかなり高いのでハタ類は網生簀養殖の対象種として重要である。

(d) フエダイ類

フエダイ類には著しい成長率と生残率を示すものが多く、飼育実験期間内では病害は見いだされなかった。

(e) その他の種

イッテンフエダイ、シマイサキ、マブタシマアジ等の魚種が飼育されたが、高い成長率を示すものは見いだされなかった。

3.1.2 汽水池を用いた養成試験

プロジェクト延長期間中には汽水池中養殖実験用の池が再整備されなかったため、実験は行わ

れなかった。さらに、資金の不足、人力の不足等が制限要因であると確認された。しかし、ボジョネガラ試験場の海水池では、餌付や施肥によって3種のアイゴの幼魚の飼育実験が行われた。(資料Ⅱ, Table 4 参照) アカメの稚仔魚についても同様の実験が計画されている。粗放的な池中養殖に関する研究は、安定した種苗生産、特にアイゴ類の安定した種苗生産を行うために必要である。

3.1.3 病害防除

数種の病害が観察され、これらに対する防疫処置が試みられたが、有効であった場合と効果の無かった場合が認められた。(資料Ⅱ, Table 5 参照)

魚類の海面養殖を確立するためには、寄生虫学、微生物学、ウィルス学の基礎知識修得が必要不可欠である。

注：対象魚種選定のための研究は第2次延長期間内でも継続されるべきである。それはこれらのデータが網生養殖だけでなく粗放養殖を行う際の適種選定に重要な情報を提供してくれるからである。

3.2 親魚養成

3.2.1 天然未成魚の採集

2種のアイゴ類の未成魚と2種のハタ類の未成魚がセリブ諸島よりうまく入手された。アカメはセカマバンランバンの河口域で採集された。海面養殖適種としての潜在性をもつ海産ナマズも同水域で採集された。セリブ諸島はアイゴ類とハタ類の未成魚の採集適地であり、一方セカマバン河口域はアカメ未成魚の採集適地であるといえる。(資料Ⅱ, Table 6 参照)

3.2.2 親魚養成

アイゴ類は、網生質内でうまく成熟し、アカメは網生質で飼育中のものにハクレンの脳下垂体を注射した。ハタ類は水槽で飼育中のものに雌を雄に変えるためのホルモン、テストステロンを注射した。フェグイ類やシマイサキなど他の魚種も親魚養成を目的として飼育された。(資料Ⅱ, Tables 7 & 14 参照) 天然の未成魚を採集し、親魚まで飼育することは、彼らの分布域および産卵時期を知るために継続させる必要がある。アイゴ類、アカメ、ハタ類および他の魚種についても親魚試験を継続する必要がある。

ホルモン処理に関するより高度な知識と技術を移転する必要がある。

3.3 種苗生産

アイゴ類の稚仔魚はバンテン湾で3月から4月にかけて採集される。水上集魚灯を使用した漁具は効果的であることが実証された。(資料Ⅱ, Table 8 参照)

アカメの稚仔魚は、2月から4月にかけてランバンの東部海岸で刺網により採集された。(付録 Table 9 参照)

ハタ類の稚仔魚はバンテン湾とセリブ諸島で採集されたが、フェグイ類の稚仔魚とイッテンフ

エダいの稚仔魚はバンテン湾でのみ採集された。シマイサキの稚仔魚はバンテン湾の網生養殖後周辺で採集された。(資料Ⅱ, Table 10参照)

3.3.2 餌料生物の培養

クロレラの培養では最適施肥量と純粋培養法が確立されたが、クロレラだけでなく、ワムシについても安定した生産がなされるよう研究が継続された。(資料Ⅱ, Table 11参照)

海産イースト菌がワムシの餌として利用可能であるかどうか実験された。(資料Ⅱ, Table 12参照)

3.3.3 人工産卵誘発

アイゴはゴナトロピンの注射により成熟が促進され、搾出法によって得られた卵で人工受精が試みられ成功した。のみならず、ホルモン処理されたアイゴは水槽内で自然産卵を行った。アカメについても人工受精が試みられたが、同様な実験は海産ナマズについても試みられるべき必要がある。(資料Ⅱ, Table 13参照)

3.3.4 網生養および水槽内での自然産卵

網生養および水槽で飼育されている2種のアイゴは、1982年9月から1983年2月にかけて毎月産卵した。(資料Ⅱ, Table 15参照)

アカメについても水槽内の自然産卵試験が継続された。

3.3.5 稚仔魚の飼育試験

2種のアイゴの稚魚については、これまで観察された高い死亡率を低下させるべく、初期餌料開発に焦点を絞って数種の試験が行われた。アカメについては、タイ国産稚魚が移殖され順調に生育した。その結果高い成長率と生残率が確認された。(資料Ⅱ, Table 16, 17, 18参照)

アイゴ類、アカメ、ハク類、フェダいの天然稚仔魚の採集は今後も計画的に実施されるべきである。アカメ、フェダイ類、ハク類、アイゴ類の人工採卵および稚仔魚の飼育は、特にカウンターパートがこれまで修得した基礎知識および技術を発揮するために、彼ら自身によって行われるべきである。

3.4 摂餌生態

陸上水槽だけでなく網生養においても各種試験が行われた。

3.4.1 成長段階毎の飽食量と飽食時間

(a) アイゴ類

2種の餌料を用いてアイゴ類の幼魚に対して最適給餌率を求めるべく試験を行った。適性給餌率は魚体の大きさによって変化し、若齢魚では高い傾向が見られた。(資料Ⅱ, Table 19参照)

(b) アカメ

アカメ稚仔魚に対しても適性給餌率が計測されたが、未だ試験中である。適性給餌率は30~40%であり、飽食率は40~50%である。(資料Ⅱ, Table 20参照)

3.4.2 各種飼餌料の栄養価の比較検討

2種の飼餌料について栄養価の評価試験を行った。

(a) アイゴ類

モイストペレットにコーンオイルを加える場合、添加量として7%が最適であるという試験結果を得た。(資料Ⅱ, Table 21 参照)

(b) アカメ

生雑魚と配合飼餌料からなる4種の餌でアカメ稚魚の飼育試験を行った。研究は現在継続中である。(資料Ⅱ, Table 22, 23 参照)

注：餌の原料とタイプは給餌率および給餌回数と同じく、魚類の海面養殖にとって基本的な重要事項である。魚の栄養要給と飼餌料の組成についても海面養殖を普及させていく際に必要不可欠の事項である。

資料Ⅱ 日・イ合同評価委員会報告書

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

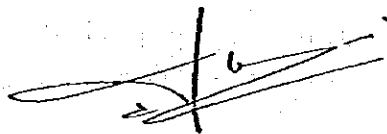
Leaving six months till the termination of cooperation period on March 31, 1984 as stated in the Record of Discussions of Extension of the Record of Discussions (hereinafter referred to as "the Extension R/D"), the Joint Evaluation Team (hereinafter referred to as "the Team") was organized for the purpose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

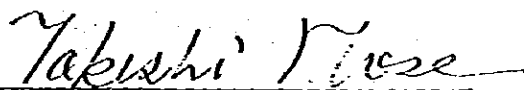
After visiting the project site and conducting a series of discussions with authorities and experts concerned, the Final Joint Evaluation Meeting was held in Jakarta on October 5, 1983.

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.

Contents

1. Introduction
2. Objectives of Evaluation
3. Method of Evaluation
4. Result of Evaluation
 - 4.1. Evaluation of research activities
 - 4.2. Measures taken by the Japanese side
 - 4.3. Countermeasures taken by the Indonesian side
5. Recommendation

ANNEX 1

ANNEX 2

ANNEX 3

ANNEX 4

ANNEX 5

ANNEX 6

Attached Documents

Summary of Project Activities Conducted during the Two Years Extension

I. Performance of Japan International Cooperation Agency

1. Dispatch of Japanese experts
2. Supply of Machinery and Equipment
3. Training Indonesian Personnel in Japan
4. Construction of Facilities

II. Results of Research Works (April 1982 - Sept. 1983)

1. Environmental Survey of Mariculture Ground
2. Shellfish Culture
3. Fish Culture

III. Attached Tables for Research Works on Fish Culture

1. INTRODUCTION

In view to developing the mariculture in Indonesia this project has been implemented for three years and seven months, based on the Record of Discussions signed on August 30, 1978. In November 1981, a joint evaluation work was conducted. As a result of the evaluation, an extension of the project for two years up to March 31, 1984 was recommended and "Extension R/D" was signed on March 31, 1982.

Project activities have been conducted on the basis of the implementation plan made in the 3-rd Joint Committee Meeting held on September 7, 1982. The cooperation in the field of shellfish culture had already been finalized on March 31, 1983. At present, the cooperation in the field of fish culture is in progress.

2. OBJECTIVES OF EVALUATION

- 2.1. To make overall review of the results of the extended project prior to its termination on March 31, 1984.
- 2.2. To discuss about the future measure to be taken after the project termination and accordingly to make recommendation to both Governments through their respective agencies.

3. METHOD OF EVALUATION

- 3.1. Evaluation work was started on September 30, 1983 and conducted by the Joint Evaluation Team as shown in Annex I.
- 3.2. Evaluation and Review were carried out on the following items based on the annual implementation plan made by the 3-rd Joint Committee Meeting as shown in Annex II.
 - 3.2.1. Project activities on research and technical development
 - 3.2.2. Measures taken by the Japanese side
 - 3.2.3. Countermeasures taken by the Indonesian side
 - 3.2.4. O t h e r s .

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.

4.2. Measures taken by the Japanese side

4.2.1. Dispatch of Experts

Three researchers and one liaison officer have been dispatched as long-term experts, while five researchers had been dispatched as short-term experts.

It is recognized that the experts have been sent adequately as planned, and have contributed much to the performance of the project.

4.2.2. Training of Indonesian Counterpart Personnel

For individual training two counterpart had been sent to Japan to study various aspects of mariculture. Counterparts having obtained good knowledge and technique are expected to carry out research work effectively.

4.2.3. Supply of equipments and machinery

Equipments for laboratory, environmental research, culture/raising and vehicles, spare parts for boats, etc., valued about 86 million yen (including future dispatch for new boat and other equipments within 1983 fiscal year budget) have been provided smoothly.

4.2.4. Others

Emergency budget (1,668 thousand yen) was expended to reconstruction of water intake system.

4.3. Countermeasures taken by the Indonesian side

4.3.1. Assignment of counterparts

The Indonesian side has assigned seven counterparts Japanese experts as a realization of the annual implementation plan and proposal of joint meeting. Consequently, the project was gradually implemented to higher activity.

4.3.2. Provided Facilities

Research facilities such as storage house, wet laboratory, a pair of thirty ton tanks and others have been provided (Annex 4). More efforts are required to level up the function of Karangantu and Bojonegara laboratories.

4.3.3. Budget for the project

It is recognized that most the problems concerning construction of facilities, man power problem, etc. are affected by the expense efficiency of budget. Efforts have been made to cope with the problems but it is still desire to speed-up accounting affairs. A sum of 387 million rupiahs has been disbursed for the project within the last two years.

4.3.4. Additional measures need to be taken to strengthen the security of the rearing experiment as a part of the management of culture 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 respective agencies that the technical cooperation period should be extended for another two years after the termination of the present cooperation stated in the Extension R/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 1. MEMBERS OF JOINT EVALUATION TEAM

ATA - 192

1. Indonesian side

- 1.1. Mr. Sofyan Ilyas, Director of Central Research Institute for Fisheries (CRIFI)
- 1.2. Dr. Purwito Martosubroto, Director of Research Institute for Marine Fisheries (RIMF)
- 1.3. Mr. A. Dwiponggo, Research Coordinator from Research Institute for Marine Fisheries
- 1.4. Mr. T. Sujastani M.Sc., Research Planning Division, CRIFI
- 1.5. Mrs. Paranshi Isbagio, Agency for Agriculture Development, Ministry of Agriculture.
- 1.6. Miss Sandra Harris, Bureau of Planning, Ministry of Agriculture.
- 1.7. Ir. Soebiyanti, Bureau of Foreign Technical Cooperation, Ministry of Agriculture
- 1.8. Mr. Didik Sodikin, Directorate General of Fisheries, Ministry of Agriculture

2. Japanese side

- 2.1. Dr. Takeshi Nose (Team Leader), Director of Nutrition and Metabolism Dept., National Research Institute of Agriculture, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries.
- 2.2. Mr. Kenichi Hamada (Cooperation Planning/Fish Culture), International Affairs. Div. Fishery Agency, Ministry of Agriculture, Forestry and Fisheries.

2.3. Mr. Masayuki Kusama (Coordination), Fisheries
Technical Cooperation Div., Forestry and Fish
Cooperation Dept., Japan International Cooperation
Agency (JICA)

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

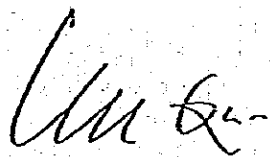
The Japanese Project Consultation Team (hereinafter referred to as "the Team"), organized by Japan International Cooperation Agency (hereinafter referred to as "JICA") and headed by Dr. Takeshi Nose, Director of Division of Fish Nutrition and Metabolism, National Research Institute of Aquaculture, Fisheries 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 further 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.

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



Mohamad Unar
Director
Central Research Institute for
Fisheries
Indonesia



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



Dr. Takeshi Nose
Leader
Japanese Project Consultation Team
Japan

A P P E N D I X

C O N T E N T S

Key Notes for mariculture research and development

- I Environmental survey of mariculture ground
- II Shellfish culture
- III Fish culture
- IV Training of Indonesian personnel in Japan
- V Dispatch of Japanese experts
- VI Provision of machinery and equipment
- VII Special requests and comments by the Japanese side

Working schedule of fish sector (Fiscal Year 1982, 1983)

Working schedule of shellfish culture (Fiscal year 1982)

Participants' list of the 3rd Joint-Committee, Japan Indonesia
Mariculture Research and Development Project

A T T A C H E D D O C U M E N T S

Progress Report of Mariculture Research and Development Project
(ATA-192), Presented for 3rd Joint Committee Meeting (Indonesia)

Data for the Third Joint Committee, Fish Sector (Japan)

1. Activities of fish sector until July 1982
2. List of activities and experiments
3. Abstracts of studies presented on December 28, 1981
4. Working schedule of fish sector for the fiscal year of 1982, 1983

Data for the Joint Committee, Shellfish sector (Japan)

1. Activities of Shellfish sector until June 1982
2. Abstracts of studies presented on December 28, 1981 meeting
3. Working schedule of shellfish sector for the fiscal year of 1982

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.

IV. Training of Indonesian personnel in Japan (September 1982 - March 1984)

1. 1982 Fiscal Year (from present to March 1983)

1) Two (2) Indonesian personnel will be accepted during the remaining 1982 Japanese fiscal year. It will be scheduled on the Indonesian side that Mr. Sadikin, Director General of Agency for Agriculture Research and Development visits Japan for general observation of mariculture from October 16-24, 1982. One more trainee is recommended for training in Japan especially focused on basic mariculture research and culture of food organisms.

2) Both of their final schedules and desirable observation/training contents will be informed JICA as soon as possible after all necessary adjustment between the Japanese Project Leader and the Indonesian Project Manager.

2. 1983 Fiscal Year (from April 1983 - March 1984)

1) As a strong request of the Indonesian side: technical training in Japan of more than three (3) personnel in considering that the fostering of Indonesian mariculture

related scientists through training in Japan is quite essential for future full-scale experimental works in the mariculture sector of Indonesia as well as the successful implementation of the Project itself.

2) As a comment of the Japanese side, maximum two (2) trainees connected with this Project will be accepted during the 1983 Japanese fiscal year. A strict budgetary limitation was also commented by the Japanese side.

V. Dispatch of Japanese experts (September 1982 - March 1983)

1. Long term experts (from present to March 1983/ March 1984)

In accordance with the relevant provisions of the R/D, Japanese long-term experts specialized in the following fields will be dispatched.

- | | | |
|----|--------------------|-----------------|
| 1) | Team leader | upto March 1984 |
| 2) | Fish Culture | Ibid |
| 3) | Fish Culture | Ibid |
| 4) | Coordinator | Ibid |
| 5) | Shell-fish Culture | upto March 1983 |

2. Short-term experts

1) 1982 Fiscal Year (present to March 1983)

Measures will be taken as soon as possible to dispatch at least three (3) short-term experts for the remaining 1982 fiscal year as follows:

- a. Chemical analysis
- b. Mariculture facility
- c. Fish culture, or
- d. Shell-fish culture

Further detailed working contents and schedules will be promptly adjusted between the Japanese Project Leader and the Indonesian Project Manager in accordance with the established annual implementation plan and its progress and should be informed JICA as soon as possible.

As a strong request of the Japanese side, Indonesian counterparts should be assigned at least when the short-term experts on chemical analysis and mariculture facility are dispatched and functioned in Indonesia. Also such counterparts should be continuously functioned during the remaining cooperation period.

2) 1983 Fiscal Year (April 1983 to March 1984)

As a strong request of the Indonesian side: the dispatching of five (5) short-term experts at least in the following fields with a view to achieving furtherly the given objectives of the Project in accordance with the established annual implementation plan:

- a. Fish culture
- b. Fish pathology
- c. Feed preparation
- d. Chemical analysis
- e. Mariculture facility

As a comment of the Japanese side, it will make as much efforts as practicable to dispatch at least three (3) short-term experts in due consideration with not only the priority to be set up by the Indonesian side but also the progress of the Project as a whole and all the relevant factors thereof.

VI. Provision of machinery and equipment

1. The both sides agreed that the Japanese Project Team Leader and the Indonesian Project Manager should hold much heavier discussions as promptly as possible with regard to the detailed contents and specifications of 1982-83 fiscal years' machinery and equipment, which will be required for future successful and effective implementation of the Project in accordance with the established annual plan as well as the provisions of Article III of the R/D and Annex III attached thereto.

2. The Indonesian side strongly requested to receive during the remaining cooperation period mariculture-related machinery, equipment, and materials for the following purposes:

1) to improve, as a tentative measures until the Indonesian side can construct all mariculture facilities especially at the Bojonegara Station in a substantially functionable manner, fresh and sea water supplies, air blower system, and electric generation.

2) to carry out at least a minimum-scale experiment and research work based upon a minimum volume of sea water supply (100 per day) at the Bojonegara Station. During the stay of the Japanese Consultation Team, such a minimum-scale work was agreed upon by the Indonesian side, because of the present conditions at the station concerning the existing mariculture and infrastructure-related facilities and machinery.

3. In connection with the provision of machinery and equipment from the Japanese side, the Indonesian side stated that an opening ceremony at the Bojonegara Station is expected to be held by

the end of March 1983. The Bojonegara Station now under construction is a field station where the Japanese side has done a model infrastructure construction and also a major field station annexed to the Karagantu Research Laboratory in Banten Bay.

VII. Special Requests and Comments by the Japanese side

The Japanese side strongly requested the Indonesian side to take the following measures for the purpose of implementing the Project in a furtherly successful way:

1. Increasement of Indonesian counterparts

In general, numerical increasement of Indonesian counterparts (including assistants) is strongly requested. This is in conformity with the Indonesian national policy, that is, the fostering of more number of mariculture-related scientists and also is essential for furtherly successful implementation of the Project.

2. Effective Protection of Fishes in Floating Cage Nets and all other Facilities.

Most effective countermeasures should be taken for protecting fishes in all cage nets/ponds and other mariculture-related experiment and research facilities especially at the Karagantu and Bojonegara Stations. A whole-day strict watching and patrol systems are definitely desired especially at the Bojonegara Station.

3. Repairment and Maintenance of Machinery and Equipment Provided by and Facilities Constructed by the Japanese Side and the Indonesian Side.

1) It is also strongly requested that all machinery and equipment, vessels, and vehicles provided by and facilities constructed by not only the Indonesian side but the Japanese side should be maintained all the times in good and effectively usable conditions with efficient budgetary guarantee of the Indonesian side.

2) Inspection and maintenance of the above-mentioned facilities and machinery should be much furtherly systematized.

4. Construction of Facilities

All the mariculture- and infrastructure-related facilities under construction or planned to be constructed by the Indonesian side especially at the Karagantu and Bojonegara Stations should be completed by its side in an effectively usable way as soon as possible, even though in the meantime experiment and research works threat will be carried out as much as possible with all the existing facilities and equipment which give considerable limitations to the experiments and research works threat.

5. 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 FISH SECTOR (FISCAL YEAR 1982, 1983)

Items	Month																								
	1982			1983			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																									
2) Rearing experiments by brickish ponds																									
3) Protection of disease																									
<u>2. Breeding of spawners</u>																									
1) Collection of natural imatured 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																									

WORKING SCHEDULE OF SUBJAPANESE SECTION FOR MARICULTURE RESEARCH AND DEVELOPMENT PROJECT (FISCAL YEAR 1982)

Items	Month												Others			
	1982 4	5	6	7	8	9	10	11	12	1983 1	2	3				
I. Environmental survey																
1) Field point observation	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	Handbook making
2) Plankton - identification	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	Handbook making
3) PSP survey	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	Water quality & heavy metal by I.P.I
4) Bacteriological	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	2nd survey. Report making.
5) Planktonic larvae & spat collection	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	Water quality & heavy metal by I.P.I
II. Technical development																
1) Green water																
a) Sample collection for mass culture																
b) Technical study for spat collection																
c) Investigation on production system																
2) Ark shell																
a) Artificial bottom culture substrate																
b) Technical study on useful species																
3) Oyster																
a) Investigation on transplantation																
b) Trial on reproduction																
c) Investigation on local systems																
4) Others																
a) Artificial seed production																
b) Trial on local culture																
c) Trial on seed production																

Participants' List (including observers)

of

the 3rd Joint-Committee

Japan-Indonesia Mariculture Research and Development Project

I. Indonesian side

1. M. Unar, Director, Central Research Institute of Fisheries
2. Sukusunu, Manager, Marine Fisheries Research Project, Marine Fisheries Research Institute
3. Wardana Ismail, Co-Project Manager ATA-192, Ancol Marine Fish Research Laboratory
4. M. Fatuchri, Head, Serang Marine Fisheries Research Laboratory
5. I. Ardha, Chief, Foreign Aid Planning Section, Bureau of Planning, Ministry of Agriculture
6. Soeyanto, Head, Subdirector of Fisheries Resources Management, Directorate General of Fisheries
7. Fuad Cholik, Head, Research Results Dissemination Division, Central Research Institute for Fisheries
8. M. Subakti, Staff, Local Government of Serang
9. Azhary, Staff, Local Government of Serang.

II. Japanese side

1. S. Kadoya, First Secretary, Embassy of Japan.
2. M. Miyamoto, Representative of Jakarta Office, Japan International Cooperation Agency (JICA)
3. K. Yoshimoto, Staff in charge of the Project, JICA Jakarta Office
4. T. Nose, Leader, Japanese Consultation Team for the Project
5. K. Fukusho, Member, Japanese Consultation Team for the Project
6. S. Funakoshi, Member, Japanese Consultation Team for the Project
7. K. Nakauchi, Staff, Fisheries Division, JICA and Member of Japanese Consultation Team for the Project
8. T. Yoshimitsu, Project Leader, Mariculture Research and Development Project (MRDP)
9. H. Tanaka, Fish Culture Expert, MRDP
10. H. Eda, Fish Culture Expert, MRDP
11. M. Hosoya, Shellfish Culture Expert, MRDP
12. M. Hiratsuka, Coordinator, MRDP

ANNEX 3

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.

ANNEX 4.

COMPLETION OF FACILITIES (1982/1983)

1. Two units of housing, Serang	April - July, 1982
2. Blower piping, ϕ 4", Bojonegara	September, 1982
3. Concrete Tank, 2 units, Bojonegara	April - June, 1982
4. Genset House, 4 X 6 m ² , Bojonegara	Sept. - Oct., 1982
5. Wet Laboratory, 160 m ² , Bojonegara	June - Sept., 1982
6. Water Corer at Guest House, Serang	Sept. - Oct., 1982
7. Water Cooling System for blower, Bojonegara	October, 1982
8. Rehabilitation of lab. and office at Karang- antu and Bojonegara	November - Dec., 1982
9. Rehab. of counterpart houses, Serang	Nov. - Dec., 1982
10. Pellet machine room, 4 X 6 m ² , Karangantu	Nov. - Dec., 1982
11. Rehab. of pond, Bojonegara	Nov. - Dec., 1982
12. Pond Construction, 2 units @ 4000 m ²	Nov. 1982 - Jan., 1983
13. Fench 300 m, Bojonegara	Feb. - March, 1983
14. Rehab. of pond, Linduk	Jan. - March, 1983
15. Completion of wet-lab, Bojonegara	Feb. - March, 1983
16. Store House, 100 m ² , Bojonegara	Feb. - April, 1983

COMPLETION OF FACILITIES (1983/1984)

1. Fench, Bojonegara	March - April, 1983
2. Water Torn and Piping in Wet-lab, Bojonegara	March - April, 1983
3. Store House 100 m ² , Bojonegara	April - June, 1983
4. Rehab. of water-intake, Bojonegara	April - June, 1983
5. Setting of chemical app., Karangantu	May, 1983
6. Setting of electrical circuit of pellet making room, Karangantu	May, 1983
7. Electrical panel for coldstorage, Bojonegara	May - June, 1983
8. Rehab. on electrical distribution of genset, Bojonegara	May - June, 1983
9. Rehab. of floor of wet-lab., Bojonegara	May - June, 1983

ANNEX -4 (Contd.,)

- | | |
|----------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| 10. Shellfish induced spawning facilities, Bojonegara | May-June, 1983 |
| 11. Rehab. of office and pier, Bojonegara | May-June, 1983 |
| 12. Sea water piping at vet-lab, Bojonegara | June-July, 1983 |
| 13. Setting of iron raft, Bojonegara | June, 1983 |
| 14. Completion of plankton room, Bojonegara | July, 1983 |
| 15. Repairment of Lencan RV, Genset, sprayer, blower,
sea water pump, Bojonegara and Karangantu | June-July, 1983 |
| 16. Completion of shellfish spawning facilities,
Bojonegara | September, 1983 |
| 17. Setting of electrical sea water pump, Bojonegara | August, 1983 |
| 18. Road construction and Deep well at Bojonegara | under process, and
will be completed
in 1983/1984 |

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 (CRIF).

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 organisa
- 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
- b. Rabbit fish
- c. Groupers
- d. Snappers
- e. Rotifers
- f. Chlorella
- g. Marine yeast
- f. Others

Lates calcarifer

Siganus spp.

Epinechelus spp.

Lutjanus spp.

Brachionus spp.

Chlorella spp.

Attached Documents

SUMMARY OF PROJECT ACTIVITIES CONDUCTED DURING
THE TWO YEARS EXTENSION

I. Performance of Japan International Cooperation Agency

1. Result of dispatch of Japanese experts (April 1982-September 1983)

1.1. Long-term experts

According to the extension R/D, Japanese long-term experts specialized in the following fields are dispatched, as planned.

- | | | |
|-----------------|----------------------|-----------------|
| 1) Team leader | Tranosuke YOSHIMITSU | upto April 1984 |
| 2) Fish culture | Hideyuki TANAKA | upto March 1984 |
| 3) Fish culture | Hiroki EDA | Ibid |
| 4) Coordinator | Tsutomu KURIHARA | Ibid |

1.2. Short term experts

1.2.1. 1982 Fiscal year

Japanese short-term experts were dispatched as follows

- | | | |
|-------------------------|-----------------|------------------------------------------------|
| 1) Chemical analysis | Eumio HIRATA | Mar, 23-Apr, 17, 1983 |
| 2) Mariculture facility | Goichi ITO | Jan, 19-Mar, 19, 1983
(Electrical Engineer) |
| 3) Fish culture | Ryo OKAMOTO | Mar, 16-Apr, 6, 1983 |
| 4) Shell-fish culture | Masahiro HOSOYA | July, 16-Mar, 31, 1983 |

1.2.2. 1983 Fiscal Year

- 1) Culture of food organism Masahiro Hosaya June, 28-September, 27, 1983 Japanese short term experts will be dispatched as follows

- 2) Chemical analysis
- 3) Fish culture
- 4) Nutrition
- 5) Fish disease

Dispatch of Japanese short-term experts is recognized to be effectively by not only Indonesian counterparts but also Japanese experts, and have contributed much to the performance of the project. In particular, expert of mariculture facility had completely fixed the wiring of Bojonegara laboratory after setting new generators. By means of this treatment, supply of electricity is stabilized.

2. Results of supply of machinery and equipment (April 1982-Sept. 1983)

In order to implement project effectively, contents and specifications of machinery and equipment were discussed in detail at regular meeting of the project. It cost about 86 million yen (including 1983 fiscal year budget). Operation of machinery and equipments is not sufficiently mastered. It is the most elementary term to understand the operation manuals thoroughly before starting operation. To operate machinery and equipments, it should be done to make a decision, who is responsibility of Indonesian side.

3. Results of training Indonesian personal in Japan. (April 1982 - September 1983)

3.1. 1982 Fiscal year

Two (2) Indonesian personal were accepted as follows

- | | | |
|-----------------------|--------------|--------------------------|
| 1). Fish culture | Siti NURAINI | March, 16-June, 29, 1983 |
| 2). Shellfish culture | WASPADA | Ibid |

3.2. 1983 Fiscal year

Two (2) Indonesian personal will be accepted.

It is recognized that technical training in Japan of counterpart fosters the projects.

4. Results of construction of facilities

Research activities at Karangantu Laboratory mainly consist of chemical analysis and environmental survey. At Bojonegara laboratory consist of fish culture and shellfish culture. It as been expected the mariculture and infrastructure facilities such as water-intake pipes and suction pumps planned to be constructed by the Indonesian side at Bojonegara laboratory.

should have been completed until the end of March 1983.

However, reconstruction of those facilities has not been completed due to lack of fund, man-power and quality. Under these circumstances, no one can continue research activity smoothly without Japanese experts. In order to acquire enough faculty of both Bojonegara and Karangantu laboratories at least, not only those reconstruction but also the items listed below should be completed.

At Bojonegara Laboratory

- 1) Arrangement of access road
- 2) Fresh water well
- 3) Reconstruction of sea-water ponds and rearrangement of its dyke
- 4) Construction of pier

At Karangantu Laboratory

- 1) Setting of telephone
- 2) Purchase and setting a transformer for pellet machine

II. Results of Research Works (April 1982-Sep.1983)

1. Environmental Survey of Mariculture Ground

According to the plan discussed and established at the 3rd Joint Committee (Sept 7, 1982), research works have been done in Banten Bay.

1.1. Routine observation of fixed points

Observation are continued at fixed points and the result has been reported in 1982 which indicated the environmental condition of the bay be stable as mariculture ground. The survey has been continued also in 1983, and the results will be reported by counterparts until the end of the term. Manual for the research methods will also be completed by the Indonesian side.

1.2. Plankton fluctuation

Overview of the distribution and fluctuation of plankton in the bay has been reported for 1980/1981. The results obtained there after will be reported by counterparts.

1.3. Bottom condition

The sandy-mud area at the eastern part of the bay, being different from the other part, was found to be adequate site to shell fish. The area has found to decrease during the rainy season. Distribution of heavy metals were also conducted at the National Oceanology Intitute (Ancol).

Remarks : The outline of the envoronmental conditions was clarified during the extended term, and back ground knowledge as well as the technique has adequately transferred to the Indonesian side. However, more practice would be needed for counterparts especially in the area of chemical analysis. Equipment for the survey should be maintained in good condition for the operation.

2. Shellfish Culture

Within the limited time of extended period of one year, the back ground technology for total production system of green mussel has been adequately transferred to the Indonesian side, and the harvest from pilot floating farm was demonstrated and celebrated with the honorable attendance of Director General of Directorate General of Fisheries. High technology for artificial induction for spawning was introduced.

2.1. Survey on the Natural Spat Fall of Bivalves

A report has been accomplished and presented concerning on this term including new and important findings in 1982. The survey has been continued by counterparts, however, more efforts should be taken for increasing information on large scale spat collection.

2.2. Technical Development of Culture Method

2.2.1. Green mussel

(a) Trials on the mass culture

Basal technology has well developed and pilot floating farm has been well maintained with successful harvest which has celebrated as mentioned above in November 1982. A manual for the culture of green mussel in Banten Bay has been finished, however, large scale spat collection being conducted by counterpart was remained unsatisfactory in 1983.

(b) Investigation on the total production system

Principally total production system has been established, however, researches should be done by the Indonesian side for expansion of the system as well as for stabilization of the system.

2.2.2. Ark Shell

Basic study on the useful species has been conducted, however, sufficient knowledge could not be obtained due to the drift of spat collectors set on the bottom of Banten Bay. The species original in the surrounding area were classified taxonomically by Prof. Horikoshi (the University of Tokyo)

2.2.3. Oyster

Investigation on Japanese and local oyster has been conducted. The oyster C. iradelei was revealed to be an adequate species for cultivation based on the comparative study on the oyster original to Indonesia as well as those introduced from Japan. Concerning the Japanese oyster, a complete life cycle could not be maintained in Banten Bay, though the growth showed excellent during the first year life. Thus, introduction of the high technology for artificial induction of spawning and larval rearing must be the key for Japanese oyster production.

Spat collection survey has been carried out twice a month at Panimbang, due to disturbance of oyster bed at Banten Bay by the fishing activity of local fishermen, however, the spat has not been collected in large number.

2.3. Artificial Seed Collection

Three reports have been presented in this term. A handbook in English version was also accomplished on cultivation of bivalve larvae. After the establishment of a wet laboratory building at Bojonegara Laboratory in March 1983, several equipments such as air-conditioned room for culture of natural feed organisms, artificial induction system for spawning, rearing tanks for larvae, have been set up until

September. These facilities must provide great opportunity for the development of artificial seed production technology, in condition that Indonesian counterparts master the technology for the operation.

New species of several diatoms have been introduced from Japan as initial diet for larval culture and the species being well cultivated in the room mentioned above.

3. Fish Culture

3.1. General Raising

More than 19 species of fish including giant seaperch, rabbit fish and groupers has been raised mostly in floating cage nets, and the feeding activity, food preference, growth rate, on feed efficiency, etc., were observed and measured (cf Table 1). These data must provide valuable information for the selection of target fish species for mariculture which must be expanded in near future. It is worth to note that in some species of fish several disease problems had occurred indicating the possible barrier for the expansion of mariculture.

3.1.1. Rearing experiments by floating cage-nets.

The following species were raised on several kinds of diet such as scrap raw fish, formulated diet and moist pellets for longer periods; 5 species of rabbit fish, giant seaperch, 5 species of groupers, 5 species of snappers and other 3 species (cf Table 2 and 3).

(a) Rabbit fishes : most of the fish showed rather low growth rate and most of them would not exceed the size of about 300 g within one year. In addition, high mortality had occurred during the experiments, resulting considerably low survival rates. The cause of disease would not be identified clearly. Several constraints were found to be resolved before the establishment of the culture.

In addition, the fish would be the target fish for extensive culture.

(b) Giant seaperch : Giant seaperch showed excellent growth rates and high survival. Few disease problems were observed.

(c) Groupers : several species of the groupers showed excellent growth rate. Thus, extensive survey should be continued for other species and survival rates were also considerably high indicating the groupers could be valuable target fish for net cage culture.

(d) Snappers : most of the snappers also showed remarkably high growth rate as well as high survival rates. No disease problems have occurred during the experiments.

(e) Other Species : Other species such as naked head snapper, banded granter, herring trevally have been raised. However, neither of these species showed high growth rate.

3.1.2. Rearing experiments by brackish pond.

The reconstruction ponds for the brackish water experiments has not been accomplished during the extended term. Thus, no experiment could be carried out in the blackish water pond. Further constraints such as lack of fund, man power so on were found to exist. However, Preliminary experiments has been conducted in the sea water ponds located at Bojonegara Laboratory using 3 species of young rabbit fish and providing supplemental diets and fertilizers. (of Table 4).

The same type of experiment is being planned for fry of giant seaperch. These researchs of extensive pond culture must contribute for stable production of seeds, especially of rabbit fish.

3.1.3. Protection of Diseases

Several diseases have been observed and several treatments have been applied for protection of these diseases (of, Table 5). Some of them were successful but others were not.

Back ground knowledge on parasitology, bacteriology, virology were keenly needed for the establishment of fish mariculture.

Remarks : Survey for possible target fish must be continued for the second extended period. These data provide valuable information for the selection of fish species adequate not only for cage nets culture but also for extensive fish culture. Importance of study on the pen culture technology was pointed out as valuable tool for fry production especially for rabbit fish.

3.2. Breeding of Spawners

3.2.1. Collection of natural immatured fish

Immatured fish of two species of rabbitfish and two groupers were selected successfully from the Seribu Islands. Giant seaperch can be collected from the estuary of River Sekampung, Lampung. Marine catfish, the potential promising species for mariculture was also caught in this water. It was concluded that the Seribu Islands is good site for collecting immatures rabbit/fish and groupers while the estuary of River Sekampung for giant seaperch (cf. Table 6).

3.2.2 Raising Spawners

Rabbitfishes successfully matured in net-cage, and giant seaperch were injected with pituitary gland of Silver carp in under raising in net-cage. Groupers injected with testosterone in order to change sex from female to male is

also under raising in the tank. Others fish for spawners such as snappers and banded grunter were also under raising (cf Tables 7 & 14) collection of natural immature fish in order to raise fish as spawner must be continued by the survey of their distribution and spawning season. Raising spawners of rabbit fishes, giant seaperch, groupers and others are still need to be continued.

Further knowledge and technology on hormonal treatment should be transferred.

3.3. Fry production

3.3.1. Collection of natural fry.

The fry of rabbitfish can be obtained from Banten Bay in a big number from March until May, Light fishing is found as a suitable gear for collecting them (cf Table 8). The seed of giant seaperch were caught by set-net in the east coast of Lampung from February until April (cf. Table 9) of groupers were collected from Banten Bay and the Seribu Islands, while those of snappers and naked head snapper were only caught in Banten Bay.

Banded grunter were collected from around the raft of cage-nets in Banten Bay (cf. Table 10).

3.3.2. Culture of Food Organisms

Optimum amount of several fertilizers and use of anti-contaminant for Chlorella culture were obtained, and efforts were continued for stable production of Chlorella and rotifer (cf. Table). The possibility of using marine yeast as feed for rotifier was examined (cf. Table 12).

3.3.3. Induced Spawning

Artificial fertilization of the eggs of rabbit fish was carried out successfully by stripping method with the injection of Gonatropin. In addition, the hormone treated fish spawned naturally in the tank.

Some trials of artificial fertilization on giant seaperch on giant seaperch and marine catfish and further experiments were found to be necessary (cf. Table 13).

3.3.4. Natural spawning in cage-nets and tanks

Cultured two species of rabbitfish spawned naturally in tank and cage-net every month from September 1982 until February 1983 (cf. Tablets 15). Experiment of natural spawning of giant seaperch is being conducted in tank.

3.3.5. Larval Rearing

Several rearing experiments were conducted on the hatches fry of two species of rabbit/fish, with the focus on the establishment of initial diet in order to decrease the high mortality observed thus far. Larva of giant sea perch transplanted successfully from Thailand were reared by standard methods, with the results of high growth rate and high survival rate (cf. Tables 16, 17 and 18).

Collection of natural fry of rabbitfish, giant seaperch, groupers and snappers should be continued intensively. Artificial breeding and larval rearing of giant seaperch, snappers, groupers and rabbitfishes should be also continued and especially conducted by Indonesian counterpart in order to demonstrate basic knowledge which had been adopted.

3.4. Experiments of Feeding Ecology in Tanks

Several experiments have been conducted not only in tanks but also in floating cage-nets.

3.4.1. Satiation amount and time at each growth stages

(a) Rabbitfish : On Rabbitfish, the most suitable feeding rate was examined using young fish with two types of food. The adequate rate of feeding was found to change upon the size of fish, being higher younger stage (cf. Table 19).

(b) Giant seaperch : Adequate feeding rate was also measured on giant sea perch fry using different feeding rates. Though the experiment is still in operation, adequate rate would be 30 - 40 % and satiation rate would be 40-50 % (cf. Table 20).

3.4.2. Comparison of food value.

Two experiments have been conducted for evaluation of food value

(a) Rabbitfish : Supplemental effect of corn oil to the moist pellet diet was studied with the best result on 7% supplementation (cf. Table 21).

(b) Giant seaperch : Four kinds of diet composed of either scrap fish, formulated diet on their combination have fed to fingerling of giant seaperch. A study of the experiment is under operation at present (cf. Table 22 and 23).

Remarks : Materials and type of diet, as well as rate of feeding and frequency of feeding is one fundamental importance for fish mariculture. The knowledge on fish nutrition and feed formulation is also needed for development of practical mariculture.

III. Attached Tables for Research Works on Fish Culture

Table 1.

English and local name of main fishes, concerned in the project during the two years extension.

English name	Local name	Scientific name
<u>1. Rabbitfishes</u>		
1) Streaky Rabbitfish	Beronang	<u>Siganus javus</u>
2) Pearl-spotted Rabbitfish	Lingkis	<u>S. canaliculatus</u>
3) Golden Rabbitfish	Beronang Lada	<u>S. guttatus</u>
4) Gold-spotted Rabbitfish	Manggilala	<u>S. chrysospiros</u>
5) Rabbitfish	Kea-Xea	<u>S. virgatus</u>
<u>2. Giant sea-perch</u>		
	Kakap	<u>Lates calcarifer</u>
<u>3. Groupers</u>		
1) Estuary Grouper	Kerapu Luspur	<u>Epinephelus tauvina</u>
2) Carpet Grouper	Kerapu Macan	<u>E. fuscoguttatus</u>
3) Black Grouper	Kerapu Balong	<u>E. terra</u>
4) Speckled-finned Grouper	Kerapu Pasir	<u>E. suzanna</u>
5) Grouper	Kerapu	<u>E. sp</u>
<u>4. Snappers</u>		
1) Red snapper	Kakap Merah	<u>Lutjanus sanguineus</u>
2) John's snapper	Jenah	<u>L. johni</u>
3) One-spot snapper	Jenah	<u>L. zonostigma</u>
4) Red snapper	Kakap Merah	<u>litjalo sp</u>
5) Mangrove Jack	Kakap Merah	<u>L. argentiraculatus</u>
<u>5. Others</u>		
1) Naked Head Snapper	Lencan	<u>Lethrinus lentjan</u>
2) Banded Grunter	Kerong-Kerong	<u>Therapon sp</u>
3) Herring-Trevally	Selar Batang	<u>Alepes kalla</u>
4) Marine Catfish	Serbilang	<u>Plotosus canius</u>

Table 2.

Initial and final sizes of fishes, experimented on growth rate in floating cage-nets

Species	Initial weight(g)	No.	Final(or Present) weight(g)	No.	Weight Increment (g)/fish	Rearing Period (month. a)
<u>S. canaliculatus</u>	23.9	634	118	161	94	8
<u>S. larus</u>	75	204	263	6	188	8
<u>S. chrysospiolos</u>	536	90	614	24	78	4
<u>S. guttatus</u>	0.5	44,000	56.5	2600	56	4 *
<u>S. vitreatus</u>	41.3	116				
<u>Lates calcarifer</u>						
I	199	41	1317	14 **	1518	12
II	479	46	794	17 **	315	2
III	1149	25	3328	17 **	2179	12
<u>E. leuina</u>						
I	110	29	1501	24	1391	9 *
II	750	14	2066	12	1356	7 *
<u>S. fuscoguttatus</u>						
I	650	24	1433 ***	23	833	14 *
II	655	22	1977 ***	22	415	3 *
<u>E. nerra</u>						
	420	6	955 ***	3	535	14 *
<u>E. sp</u>						
	81.1	37	276	11	195	9 *
<u>E. subzona</u>						
I	171	24				
II	453	19				
<u>L. sanguineus</u>						
	155	} 25	1295	6	1140	9 *
<u>Pinalo sp</u>	155		933	10	783	9 *
<u>L. sanguineus</u>						
<u>Pinalo sp</u>	} 200	103	352	104	152	2 *
<u>Pinalo sp</u>						
<u>L. johni</u>						
I	191	7	901	7	710	7 *
II	145	93	305	91	161	2 *
<u>L. nobostiza</u>						
	114	17	199	9	85	7 *
<u>L. arctifasciatus</u>						
	15.5	11	71.3	11	55.8	2 *
<u>L. leatjan</u>						
	55.2	44	161	33	106	10 *
<u>Therapon sp</u>						
	2.16	415	91.3	193	89.1	7 *
<u>Aleces kalla</u>						
	18.6	150	32.9	89	14.3	5

Note : * Still experiment

** Low yielding caused by disappearance of fishes

*** There were observed some stagnation of growth during their experiments.

Table 3.

Other fishes except under experiment, stocked at present
in the floating cage-nets

Species	Mean body weight (g)	Number of fish
<u>S. canaliculatus</u>	2.5 - 44.0	500
<u>S. javus</u>	5.8 - 37.5	400
Red Snappers	200 - 400	26
<u>L. johoi</u>	200 - 600	56
<u>L. zonostigma</u>	100 - 200	54
Other Snappers		20
<u>L. lentian</u>	50 - 200	88
<u>Plectrohynchus pictus</u>	100 - 300	3
<u>E. fuscozuttatus</u>	300 - 300	14
Other Groupers	200 - 5,000	93

Table 4.

Preliminary experiment on an extensive culture
of Rabbitfish in marine pond

Items	Description
Area of pond used	: 450 m ²
Time stocked	: June 1985
Fertilizer used	: Chicken manure and inorganic fertilizers
Species and number stocked	: <u>S. canaliculatus</u> ; 592 fish : <u>S. javus</u> ; 577 : <u>S. guttatus</u> ; 569
Mean body weight	: 0.4 g / fish
Supplementary feed used	: Moist pellet

Table 7.

Total number of spawners under raising at present
in the floating cage-nets and expected spawning time

Species	Number	Body weight (g)	Spawning time expected
<u>S. canaliculatus</u>	50	100 - 200	Aug. - Feb. 1984
<u>S. virgatus</u>	6	80 - 150	Oct. -
<u>S. javus</u>	22	250 - 300	?
<u>L. calcarifer</u>	24	4,000 - 10,000	Dec. - Feb. 1984
<u>E. fuscoguttatus</u>	15	1,500 - 8,000	?
<u>L. sanguineus</u>	6	1,300	Dec. -
<u>Pinjalo</u> sp.	10	950	?
<u>L. johoi</u>	7	900	?
<u>Therapon</u> sp.	198	90	Oct. -

Table 8.

Number of Rabbitfish fry captured in Banten Bay

Main species	Time	Number	Body weight	Fishing gear used
<u>S. canaliculatus</u>	March - May 1982	69,000	0.5 g	Seine-net
-- " --	May	9,000	0.5	Light-fishing
-- " --	Oct. - Nov.	3,600	0.5	Seine-net
-- " --	Feb. - April 1983	39,000	0.5	Seine-net
<u>S. guttatus</u> and <u>S. javus</u>	May	210,000	0.4 - 1.0	Light-fishing
-- " --	May	43,000	0.4 - 1.0	Commercial seine-net

Table 9

Result on survey of giant seaperch at east coast of Lampung,
especially in collected number (1982 - 1983)

Month	Number of fish						Remark
	20 - 100g	100 - 500g	500g - 1kg	1 - 12kg			
1982							
May	12	67	27	0			
Jun	0	27	0	0			
Oct	0	0	3	4			:beginning of spawning season
Nov	0	0	2	5			
Dec	0	0	8	9			
1983							
Jan	0	0	3	3			
Feb	12	2	0	11			:End of spawning season
Mar	63	329	0	0			
Jan	5	145	14	0			
Aug	1	5	4	0			

Table 10.

Number of young fishes collected from natural
for the rearing experiments

Species	Number	Mean body weight (g)	Place collected
<i>S. virgatus</i>	121	41.3	Kongsi island
<i>L. calcarifer</i>	733	20 - 500	Sekampong
<i>E. laurina</i>	51	110 - 250	Banten Bay
<i>E. sp</i>	75	107	- " -
Groupers	37	191	- " -
<i>E. fuscoguttatus</i>	11	673	Kongsi island
<i>E. süssana</i>	34	211	- " -
Red Snappers	231	85	Banten Bay
<i>L. johni</i>	205	135	- " -
<i>L. monostigma</i>	31	55	- " -
<i>Leth. leotjan</i>	154	55	- " -
<i>Therapon</i> sp	413	2.2	- " -

Table 11.

Species cultured as food organisms for feeding to larvae of fish
and their maximum densities obtained

Species	Density/Production	Feed used
Marine Chlorella (<i>Chlorella</i> sp)	38 x 10 ⁶ cell/cc	Fertilizers ; Ammonium Sulfate Urea, TSP and NPK
Rotifer (<i>Brachionus</i> <i>plicatilis</i>)	220-240 ind./cc	Chlorella Baker's yeast Marine yeast
Copepoda (Mainly <i>Acartia</i> sp)	I 602 g/month/ 30 ton sea-water II 234 g /m/30 t	Formulated diets for Sea-Bream and Common carp

Note : . ; Produced together with Rotifer

Table 12.

Ingredients of medium used for marine yeast culture

Ingredients	Amount / Litre
Coconut sugar	30 g
Ammonium Sulfate	3 g
TSP	1 g
HCl	1 ml

Table 13.

Experiments on artificial egg collection and induced spawning conducted

Species	Kinds of hormone used	Fertilization method	Result
<u>S. canaliculatus</u>	" Gonatropin "	Stripped, dry	800,000 eggs obtained, Excellent hatching
-- " --	-- " --	Natural spawning	Over 80,000 larvae hatched
-- " --	Pituitary gland of Silver carp	Natural spawning	1,000 larvae hatched
<u>Lates calcarifer</u>	" Gonatropin "	Male; Removed Female; Removed, wet	As practice
<u>Plotosus canius</u>	No	M ; Removed F ; Stripped, wet	As practice

Table 14.

Trials of induced maturation

Species	No. of spawners injected	Injection			Time
		Hormone	Solvent	Dose	
<u>Lates calcarifer</u>	I 10	Pituitary gland* of Silver carp	0.6 % NaCl	0.5 gland/kg fish	Aug. 1983
	II 24	-- " --	-- " --	-- " --	Sep.
<u>E. fuscocattatus</u>	I 10	Testosterone**	Vitamine E	5 mg/fish	Aug. 1983
	II 9	-- " --	-- " --	7 mg/fish	Sep.

Note : * ; In order to accelerate maturation both male and female.

** ; In order to change sex to male and also to mature.

Table 15

Natural spawning of Rabbit fish

Case	Species	Month	No. of female	Result
1	: <u>S. virgatus</u> :	1982 Sep :	2	: 100,000 larvae hatched
2	: " :	Oct :	1	: 550,000 "
3	: " :	Nov :	1	: 97,000 "
4	: " :	Dec :	1	: 65,000 "
5	: " :	1993 Jan :	-	: -
6	: <u>S. canaliculatus</u> :	Jan :	-	: Spawned in cage nets
7	: " :	Feb :	4	: 450,000 eggs obtained but not hatched out

Table 16
Experiment of larvae Rearing

Case	Species	Month	No. of larvae	Tank (lts)	Result
1	<i>S. virgatus</i>	1982 Sep	10,000	1	High mortality observed on 2nd day after hatching all died until 17th day.
2	"	Nov	10,000	0.5	High mortality observed on 2nd day all died until 14th day.
"	"	"	15,000	0.5	"
3	<i>S. canaliculatus</i>	1983 Aug	50,000	1	High mortality on 2nd day by aeration stop reared until 20th day
"	"	"	50,000	1	"
4	"	"	100,000 (fertilized eggs)	10	All died until 25th day
5	<i>S. calcarifer</i>	1983 Jan	2,500	0.5-3	After 3 month reared, mean body weight 9.55 (range 2 - 55g), survival rate 23.2%

* Transported from Thailand, 20 days old larvae.

Table 17

Initial food organisms used for rearing Rabbit fish larvae

Species	Period used	Remarks
Fertilized eggs	from 2nd day	Obtained by induced spawning of grass mussels
Filtered rotifer	2nd - 6th day	Filtered by No. 10 mesh
Scudifer	7th - 20th day	Cultured by chlorella
Copepoda	from 15th day	Cultured and collected from natural
Artemia (Nauplius)	from 20th day	

Table 18

Initial food organisms used for rearing Giant sea perch larvae

Species	Period used	Remarks
Scudifer	20th - 24th day	
Artemia (Nauplius)	20th - 45th day	
Fresh water cladocera	25th - 33rd day	Moira sp
Copepoda	25th - 55th day	Collected from natural
Mixed fish	34th -	<i>Stoleboerus</i> spp

* Days after hatched out.

Table 19

Results of experiment on suitable feeding rate for young Rabbit fish (*S. caudicatus*) in floating cage net

Body weight (g)	Suitable feeding rate (in dry weight)
5	12 % / day
10	8 % / day
15 - 20	5 % / day

Table 20

Interim result of experiment on adequate feeding rate of Giant sea perch fry

Percent of feeding (%)	Initial weight (g)	No. of fish	Interim result weight (g)	No. of fish	Weight increment (g/fish)	Period (week)
20	2.66	30	7.45	30	4.79	3
30	2.66	30	9.23	30	6.57	3
40	2.66	30	10.56	30	7.90	3
50	2.66	30	10.70	30	8.04	3
60	2.66	30	10.20	30	7.54	3

* Mixed fish, *Stolephorus* spp % / body weight.
 ** This experiment still in operation.

Table 21

Result of experiment on supplemental effect of corn oil to the moist pellet diet of Rabbit fish (*S. caudicatus*)

Supplemental rate of corn oil	Result
7% / diet	Excellent growth showed
5% / diet	Good growth showed
3% / diet	Almost same growth showed as 0%
0% (control)	

Table 22

Result of experiment on growth and survival rate of the fry stage of Giant sea perch fed with four kinds of diet.

Kind of diet	Result	Remark
Minced fish	: Excellent growth and high survival obtained	: <i>Stolephorus</i> spp used as diet
Moist pellet	: Good growth and high survival obtained	: Minced fish with formulated diet
Minced green mussel	: Poor growth and low survival obtained	:
Formulated diet	: High survival but no growth observed	: Formulated diet for carp

Table 23

*** Lateris result of experiment on growth rate of Giant sea perch fed with different kinds of diet in floating cage net.

Kind of diet	Initial weight : (g)	No. of fish	Lateris result weight : (g)	No. of fish	Weight increment : (g)	Period (month)
Scrap fish	: 255	: 39	: 455	: 39	: 170	: 2
Tilapia	: 287	: 39	: 454	: 39	: 167	: 2
Moist pellet	: 278	: 39	: 433	: 39	: 155	: 2
Formulated diet	: 293	: 33	: 366	: 24	: 68	: 2

- * Scrap fish with formulated diet
- ** Formulated diet for carp
- *** This experiment still in operation.