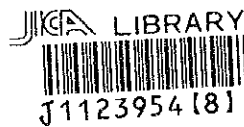


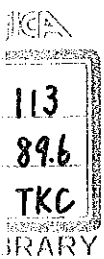
平成6年度 帰国研修員フォローアップチーム 報告書

(養殖一般コース・エビ増養殖技術コース)

平成7年2月



国際協力事業団
神奈川国際水産研修センター



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序 文

当事業団は、神奈川国際水産研修センターおよび山口県内海栽培漁業センターにおいてそれぞれ実施してきた養殖一般、エビ増養殖技術コースに参加した帰国研修員に対するフォローアップ業務の一環として、本調査団を平成6年9月28日から10月15日まで東京水産大学教授 多紀保彦博士を団長として、マレーシアおよびスリ・ランカの2ヵ国に派遣した。

本調査では、養殖分野の現地適正技術および日本のエビ増養殖技術の紹介を行い、現在の養殖技術上の問題点等についてセミナー参加者とともに考え、わが国の研修に対するニーズを把握し、今後の当該分野における円滑なコース運営のための資料とした。

本報告書は、これら調査結果をとりまとめたものであり、関係各位の参考として役立つことを願うものである。

終わりに、本調査の実施に際し、ご協力を賜った関係者並びに調査団員に深甚の謝意を表すとともに、今後のご協力をお願いする次第である。

平成7年2月



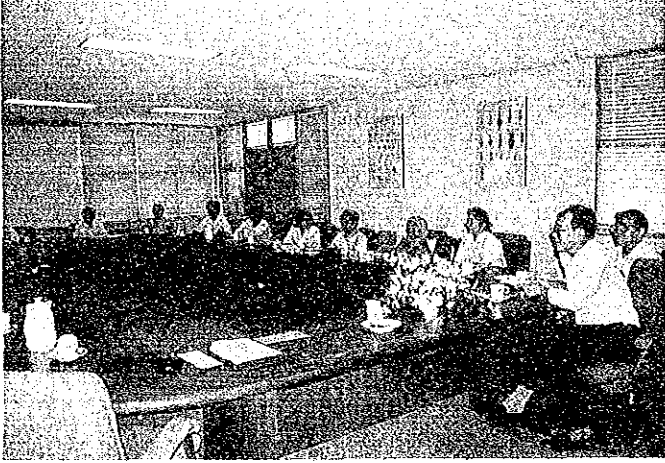
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国際協力事業団

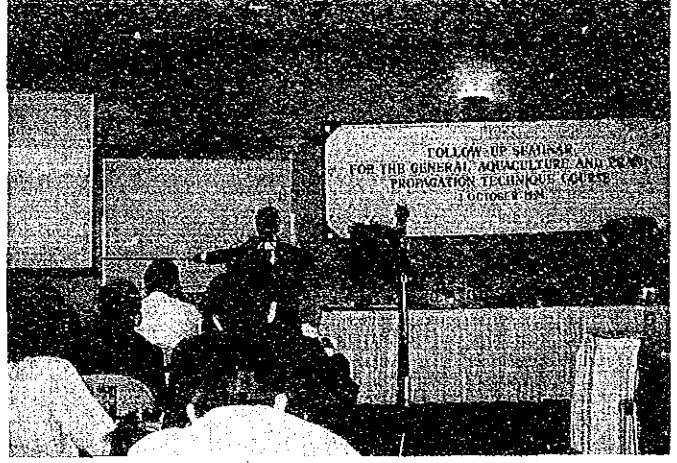
神奈川国際水産研修センター

所長 尾 島 起 己

マレーシア



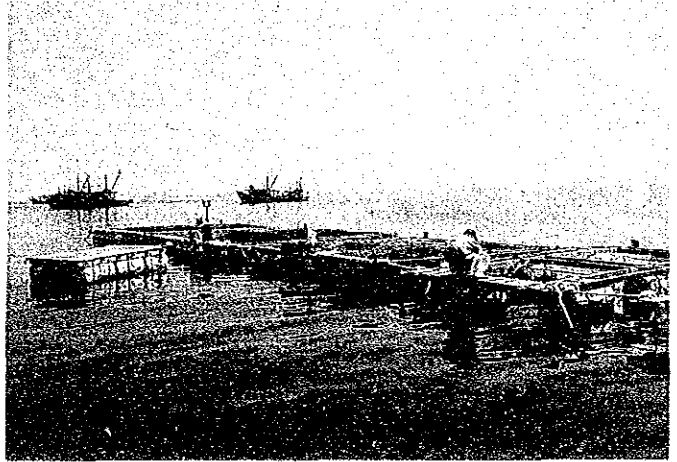
国立エビ種苗生産研究センターにおける
帰国研修員との面談風景



クアラルン・プールでのフォローアップ・
セミナー風景

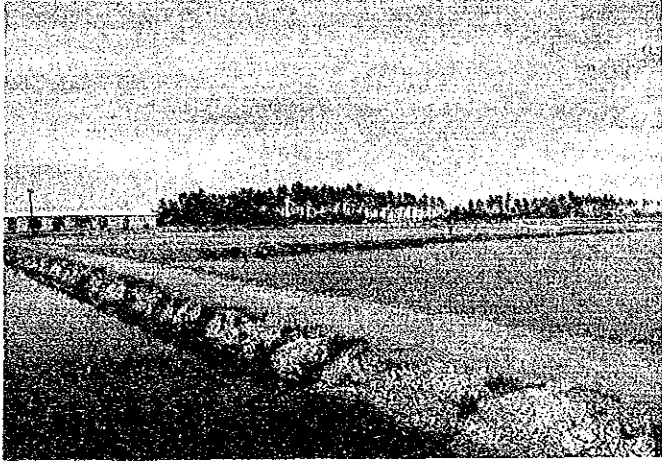


サバ州におけるシロチョウガイ養殖風景

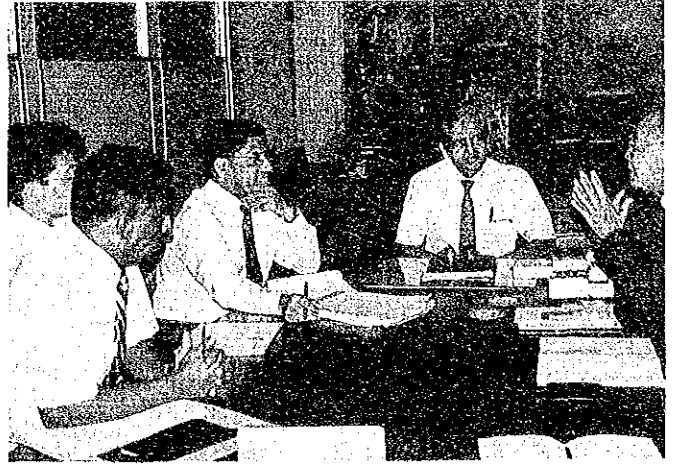


サバ州の民間ハタ養殖場

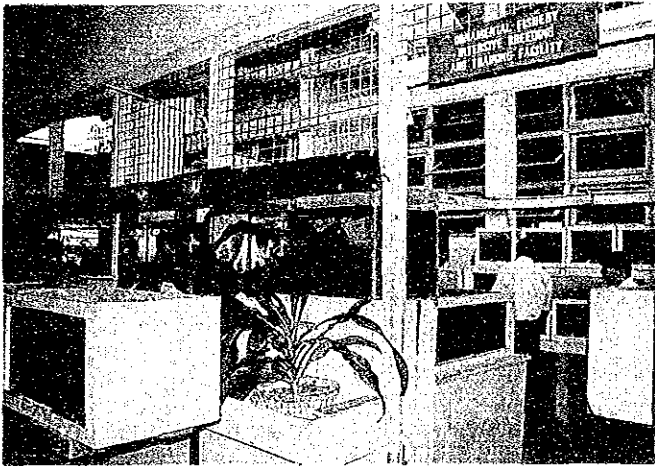
スリ・ランカ



チラウにあるエビ養殖企業の養殖池



漁業水産資源省におけるインタビュー



国立水産資源局（NARA）本部にある観賞魚
養殖研究部門



コロomboでのフォローアップ・セミナー 風景

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1. 調査の目的

本調査の目的は以下の三つに分けられる。

- (1) 帰国研修員およびその所属先（水産関連行政、研究機関）担当者に会い、研修成果、現在の仕事等を聴取し、また日本で研修成果の評価、今後の研修に対する要望、改善点等について国際協力窓口機関等の担当者と協議する。
- (2) フォローアップ・セミナーを開催し、日本における養殖技術の現状を紹介するとともに当該国の養殖技術、問題点等につき意見交換する。
- (3) 養殖分野を中心とした当該国の水産事情を調査し、今後の研修実施の参考とする。

2. 団員構成

団長（総括）	多紀 保彦	（東京水産大学 教授）
団員（技術指導）	藤島 浩晃	（水産庁振興部開発課 調査指導係長）
団員（技術指導）	宮後 富博	（社団法人 山口県栽培漁業公社 専門研究員）
団員（業務調整）	前川 晶	（JICA 神奈川国際水産研修センター）

3. 調査日程

- 9月28日(水) 東京→クアラルン・プール (JL723)
29日(木) JICA事務所打合せ、人事院 (PSD) 訪問
30日(金) 漁業公社 (LKIM) 訪問、マレイシア農科大学 (UPM) 訪問
10月1日(土) クアラルン・プール→プラウ・サヤ 国立エビ種苗生産研究センター訪問
2日(日) フォローアップ・セミナー (於 国立エビ種苗生産研究センター)
プラウ・サヤ→クアラルン・プール
3日(月) フォローアップ・セミナー (於 ホテルエクアトリアル)
4日(火) クアラルン・プール→クチン (MH2514)
5日(水) サラワク州漁業公社訪問 クチン→コタ・キナバル (MH2610)
6日(木) サバ州水産局訪問、民間養殖場 (ハタ)、水産局養殖場視察
サバ州水産研究所訪問
7日(金) コタ・キナバル→シンガポール (MH631) シンガポール→コロンボ (UL313)
8日(土) コロンボ→キリンダ キリンダ周辺養殖事情視察
9日(日) タンゴール漁業研修所訪問、ゴール周辺養殖事情視察 キリンダ→コロンボ
10日(月) JICA事務所打合せ、政策計画実施省外局資源局、国家計画局訪問
漁業水産資源省訪問、日本大使館訪問
11日(火) フォローアップ・セミナー (於 タージサムドラホテル)
12日(水) コロンボ→チラウ 民間エビ養殖場視察
13日(木) チラウ→ニコンボ 水産資源局 (NARA) 訪問、水産研修センター訪問
ニコンボ→コロンボ
14日(金) コロンボ→バンコク (TG308)
15日(土) バンコク→東京 (JL718)

4. 主要面会者リスト

(マレーシア)

Mr. Mohd. Tajudin Don	Asst. Director, Look East Policy Section, Training Div., Public Service Dept.
Mr. Mohd. Norpi Bin Abu Hassan	Fisheries Development Officer, Fisheries Development Authority Malaysia (LKIM)
Dr. Ridzwan Abdul Rahman	Deputy Dean, Faculty of Fisheries and Marine Science, Universiti Pertanian Malaysia (UPM)
Dr. Hassan B. Hj. Mohd Daud	Dept. of Aquaculture, Faculty of Fisheries and Marine Science, UPM
Ms. Shahima Ab. Hamid	Training Officer, Dept. of Fisheries (DOF) Ministry of Agriculture
Mr. Liong Pit Chong	Chief (Director), National Prawn Fry Production and Research Centre (NAPFRI)
Dr. Ibrahim Saleh	Director, Fisheries Research Institute of Penang
Mr. Untong B. Keri	Economic Affairs Officer, Marine Fisheries Dept., LKIM State Sarawak
Mr. Resad B. Diccah	Asst. Economic Affairs Officer, Fisherman Community Dept., LKIM State Sarawak
Mr. Razak Hassan	Technical Asst., Engineering Unit, LKIM State Sarawak
Mr. Mohd. Khir Mohd. Sham	Economic Affairs Officer, Marketing Div., LKIM State Sarawak
Mr. Kusuadi B. Salset	Economic Affairs Officer, Aquaculture Div., LKIM State Sarawak
Mr. Saadi Bin Samaon	General Manager, Revlin SDN. BHD.
Datuk. Joseph Wong Tung Sang	Director, Dept. of Fisheries, State Sabah
Mr. Boniface Mosios	Fisheries Officer, Dept. of Fisheries, State Sabah
Mr. Tang Twen Poh	General Manager, Aquaculture Technology SDN. BHD.
Mr. Yoshihiro Makino	Staff, Aquaculture Technology SDN. BHD.
Mr. Ronnie C. Jimulis	Red Tide Section, Fisheries Dept., Fisheries Research Institute, State Sabah
神原康次	在マレーシア日本国大使館 二等書記官
水田加代子	JICA マレーシア事務所 所長

貝原孝雄

JICA マレーシア事務所 次長

有田敏行

JICA マレーシア事務所 職員

瀬尾重治

マレーシア農科大学海洋水産学部拡充計画アフターケア派遣専門家

(スリランカ)

Mr. Faiz Mohideen

Additional Director General,
National Planning Department, Ministry of
Policy Planning and Implementation
Deputy Director, Department of External
Resources, Ministry of Policy Planning
and Implementation

Mr. K.H. Camillus Fernando

Secretary, Ministry of Fisheries and
Aquatic Resources

Mr. A. Hettiarachchi

Director of Planning,
Ministry of Fisheries and Aquatic Resources

Mr. A.M. Jayasekara

Director of Inland Fisheries Development,
Ministry of Fisheries and Aquatic
Resources

Mr. M.H. Gunawardena

Ex-Senior Fishery Officer,
FAO/World Bank Cooperative Programme
Investment Centre

Dr. M.U. Jayasekara

Director General,
National Aquatic Resources Agency

Dr. J.M.P.K. Jayasinghe

Director of Inland Aquatic Resources,
National Aquatic Resources Agency

Dr. Pauline Dayaratne

Director of Marine Biological Resources
Div., National Aquatic Resources Agency

Mr. D.J. Amarasuriya

Director of Studies,
Colombo International Nautical and
Engineering College

Mr. K.S.B. Tennakoon

General Manager,
Sea Food Exporters Consortium Ltd.

Mr. D. Dammika Sumitta

Operational Manager,
Indiwary Aqua Ltd.

森本康裕

在スリランカ日本国大使館 三等書記官

中村欣功

JICA スリ・ランカ事務所 所長

飯田次郎

JICA スリ・ランカ事務所 職員

Mr. M.N. Perera

Staff,
JICA Sri Lanka Office

5. 帰国研修員に対する調査結果

マレーシアでは両コース合せて帰国研修員8名のうちの6名と、スリ・ランカでは10名のうちの2名とそれぞれ面会し、日本での研修の成果、現在の仕事、将来の研修コース改編等について意見を聴取した。

その結果、日本での研修については大旨満足しており、研修で学んだことが現在の仕事の上で直接、間接に活用できているとの評価であった。今後の研修に対する期待の点では、魚病防疫や栄養学、遺伝学などの高度かつ特化したテーマの研修参加の希望が多く聞かれた。

面談の結果及びあらかじめJICA事務所経由で送付した研修に関するアンケートの結果をまとめると次表のとおりとなる。

帰国研修員氏名及び現職	参加年度	コース名	意見
(マレーシア) ※注			
Mr. Subrahimanian s/o K. 国立エビ種苗生産研究 センター研究員	1980 1992	養殖一般 魚類防疫	研修は非常に有意義で特にエビの種苗生産、ワムシ等の生物餌料生産技術が役立っている。
Ms. Faazaz Bt. Abd. L. 国立エビ種苗生産研究 センター研究員	1988	エビ増養殖	研修期間が少し長過ぎた。
Ms. Rashidah Mat Resat 国立エビ種苗生産研究 センター研究員	1990	エビ増養殖	問題点として、講師の数人が英語能力が低く、また通訳も専門用語が理解できない苦労があった。幼生飼育技術が現在役立っている。
Mr. Mohamad Jamail B. K. 国立エビ種苗生産研究 センター研究員	1992	エビ増養殖	エビ繁殖生理と親エビ養成技術が有効であった。最新の養殖技術情報の提供を望む。
Mr. Mohd. F. Othman 国立エビ種苗生産研究 センター研究員	1993	エビ増養殖	大量種苗生産、魚病コントロール、餌料生物培養、エビ輸送技術など大変有効であった。研修効果を測定し、それに応じた技術支援を望む。
Mr. Saadi B. Samion Revlín Holding Sdn Bhd. 顧問 (サラワク州)	1982	養殖一般	日本式の養殖方法を学ぶことができたのは有意義で、帰国後しばらく網生簀を使ったアカメの養殖を試みた。養殖地の選定や養殖池の設計等の技術、理論が有効であった。現在は家禽加工を中心とした経営を行っている。

※注 当該研究員は2コースに参加

帰国研修員氏名及び現職	参加年度	コース名	意見
(スリランカ) Mr. A. Hettiaratchi 漁業水産資源省計画局長	1980	養殖一般	91年まで就いていた養殖研究の仕事の上で特にコイとエビの養殖技術と養殖池の水質管理等が有効であった。
Mr. W. A. Sumanadasa 水産資源局研究員	1991	エビ増養殖	近代的養殖研究機器の使い方、研究施設運営方法が有効。

本調査で面会はできなかったが、アンケート用紙の回収によって得られた帰国研修員の意見をまとめると次表のとおり。

帰国研修員氏名及び現職	参加年度	コース名	意見
(スリランカ) Mr. P. R. P. Seneviratne Aqua Gardens Ltd. 社長	1984	養殖一般	エビの病理学、微細藻類培養、エビ幼生飼育技術が非常に有効であり、現在大変役立っている。
Mr. K. Kanankege ワヤンバ開発公社水産計画長	1983	養殖一般	テトラピア養殖技術、コイの脳下垂体の摘出、クルマエビの飼育技術が特に有効であった。
Mr. H. A. M. Kulatilaka 漁業水産資源省養殖担当	1987	養殖一般	コイとエビの養殖技術、水質管理、魚病診断が特に有効であった。

また、本調査の直接の対象ではないが、JICAの他の水産関連研修に参加した帰国研修員に面会し、意見を聞く機会があった。

帰国研修員氏名及び現職	参加年度	コース名	意見
(マレーシア) Mr. Liong Pit Chong 国立エビ種苗生産研究センター所長	1989	個別(水産事情視察)	研修監理員が専門用語を理解できなかったため、研修効果の点で影響があった。
Mr. Yaakob Bin Ahmad 国立エビ種苗生産研究センター研究員	1987	個別(エビ種苗生産)	三井農林産業㈱での1カ月の研修は有意義であった。

この他にも面会した他の水産関連研修参加経験者がいたが、直接研修効果に関する意見を聞くことができなかったため、省略することにする。

帰国研修員がアフターケア事業として要望するものは、最新の養殖技術や研究に関する文献や図書の供与が最も多く、その他不足している機材の供与や専門家派遣による指導を望む声も聞かれた。

帰国研修員同窓会の活動としては、マレーシアでは特筆するほどのものはなく、半島部を除いては同窓会からの案内や照会は全く無い状態で、同窓会の存在を知らない者もいた。スリ・ランカにおいては活発に定期会合やイベント等が開催され、帰国研修員の会への参加も良いようである。

帰国研修員の定着率は、マレーシアでは研修参加前と参加後でほとんどの者が同一組織で同一身分であり、非常に良い。これは国家として安定した養殖研究体制を推進していることの現れといえよう。一方スリ・ランカではエビを除いて養殖事業及び研究体制は極めてプリミティブな状態で、国家としてまだ手探りの状態といえよう。そのことが帰国研修員の定着率にも反映しており、特に養殖一般コース参加者の定着率が低い。本調査の結果判明した範囲では、漁業水産資源省の計画局長になった Mr. A. Hettiaratchi 他1名が元の所属で養殖関連事業に携わるのみで、残りは民間で養殖事業に従事するか、全く消息が不明の者もいた。

6. 研修関係者に対する調査結果

ここでいう研修関係者とは、研修員の所属先である水産関係行政機関、研究所及び研修に関する要請をとりまとめ日本国政府に提出する技協窓口機関を指す。

マレーシアにおいては、人事院(PSD)、農業省水産局(DOF)、漁業公社(LKI

M)、国立エビ種苗生産研究センター (NAPFRE) において意見を聴取し、スリ・ランカにおいては、政策計画実施省外局資源局、漁業水産資源省等から意見を聞いた。

日本での研修の成果については、その評価方法がマレーシアにおいてもスリ・ランカにおいても所属機関を通して提出を義務付けているレポートによるだけであり、正確に研修成果を推し測ることは困難な現状である。

マレーシアにおいては、JICAの研修に重点を置き、日本での研修終了時に手交される研修修了証書は昇進や昇級等の考慮材料とされるとPSD担当官の説明を聞いた。また、マレーシアが日本での研修に参加させやすい条件として、研修期間3ヵ月以内が適切であるとの意見が聞かれた。

PSD担当によれば、マレーシアの国家開発計画における水産分野の優先度は低く、工業分野の研修要請が最優先であるようだ。ただし水産関係行政担当者の見方は異なっており、水産分野の中でも特に養殖や遠洋漁業の振興には政府も力を入れているとのことであった。

研修への参加基準については、適材適所が原則で、集団研修コースの場合その内容、レベルに応じた人物を厳選しているとのことであったが、時に研修員のレベルと研修で要求されるレベルに相違が生じ、十分な研修成果を上げることができなかったケースがあったようだ。

スリ・ランカでは、食料増産分野に最優先のプライオリティを置いており、全てのセクターに占める水産分野の優先度は非常に高いものがある。水産分野の中では遠洋漁業と海面養殖 (特にエビ) に優先度が置かれている。水産分野ではほぼ毎年一人が日本での集団研修コースに参加している。

7. フォローアップ・セミナーの概要

本セミナーは、マレーシア、スリ・ランカ両国ともに、

(1) 日本の (特に山口県における) クルマエビ養殖の現状と問題点

(2) 熱帯地域における増養殖の現状と展望

の2題目について行った。また、併せて JICA事業の説明および両国において実施された JICAの水産協力事業の説明を行った。それぞれの概要は以下のとおりである。

(1) 日本の (特に山口県における) クルマエビ養殖の現状と問題点

1930年代に最初のクルマエビの人工種苗生産の試みがなされてから、今日の養殖技術の確立に至るまでには、その歴史において様々の技術開発上の変革があった。

ゾエア期用の餌であるけい藻の大量培養の成功や、ミシスおよびポストラーバ期の

アルテミアの安定確保が大きな貢献をもたらした。

1964年、藤永、橘高氏がそれまでのモノカルチャーシステムに代って、コミュニティーカルチャーシステムを開発してから、クルマエビ種苗は大量生産されるようになった。

大量種苗生産とともに生餌の与え過ぎによる水質悪化の問題が起こったが、鹿児島方式におけるイカを原料とした配合餌料が開発され、これを解決した。

また、鹿児島大学の金沢教授がゾエア期のけい藻の補助餌料としてmicro artificial diet を開発し、現在では多くの餌料会社が製品を出している。

親エビの人工成熟、産卵誘発は眼柄切除法等で行われてはいるが、依然技術的な問題があり、十分な成果が出ていない。近い将来餌料の開発によってこの問題も解決されるかもしれない。

現在山口県で行われているクルマエビ養殖の方法について、多数のスライドを用いて説明した。山口県内海栽培漁業センターでは、年間330万尾のポストラーバを生産している。困難な問題として、BMNDやappendage necrosis disease 等のほとんど100%に近い致死率をもたらす病気が発生し、その防除策が検討されている。

(2) 熱帯地域における増養殖の現状と展望

熱帯地域（特に東南アジア地域）における養殖は、地方のたん白源を供給する地域消費的なものから、外貨獲得や高級レストラン向けのエビや高級魚等を対象とした集約的養殖へと近年変化してきた。

養殖方法が集約的になるに伴い、養殖場の環境悪化、水質汚濁の問題が深刻化している。

このような状況下、いわゆる粗放的養殖がその重要性の点で注目されてきている。本題目では、熱帯地域における海面養殖と淡水養殖を生物学的、技術的、経済学的に比較検討し、粗放的養殖、集約的養殖のそれぞれの方法についてその問題点、および今後の展望について、セミナー参加者とともに議論した。

8. 当該国における水産（特に養殖）分野の現状と問題点

8-1 マレーシア

(1) 養殖の現状

マレーシアの漁業生産の規模は、近隣のASEAN諸国に比較して小さく、また国家開発計画に占める水産分野の優先順位も高くはない。しかし、人口も少ないところから、国民一人あたりの生産量、生産額（1990年でそれぞれ62.3kg、US \$45.4）では近隣諸国に匹敵するかあるいはそれを上回っている。これは、近年における海面漁

業特に遠洋漁業の振興に負うところが大きく、後述のように養殖生産に関してはマレーシアはASEAN諸国の中では後発であり、生産も他国に比べ高くない。

マレーシアの行政組織には連邦政府と州政府があり、州政府はかなりの自治権を持っている。水産行政を統括する機関は連邦農業省水産局(DOF)であり、各州に連邦直属の州水産局を置き、試験研究機関としてはペナンやケダ、トレンガヌ等に水産研究所がある。また、漁民所得の向上と水産業界の育成を目的とするFisheries Development Authority(LKIM)を1971年にDOFの外郭団体として設置し、水産物の市場流通、水産施設の貸与、漁民組織の育成、養殖産業の振興等にかかわる業務を行っている。

ただし、サバ州においては、州農業省の水産局が連邦政府水産局とは行政的にまったく独立した地位にあって州の水産行政全般を統括し、またLKIMに代わるKongkoy Nelayanという漁業公社的な組織が存在する。LKIMはサバ州との関係を保持する目的で、同州に6名程度のliaison officerをおいている。これらの行政機関のほかに、マレーシア農科大学(UPM)海洋水産学部も、大学の任務一つとして、教育、研究のほかに水産普及活動を行っている。

マレーシアの養殖生産は、この20年来一部の例外年を除いて4万~5万トン台で推移しており、量的な増加傾向は見られない。しかしその内容は大きな変遷を示している。すなわち、この国の養殖は以前はハイガイの海水養殖が中心であったが、その生産は減少し、それに代わってアカメ、ハタ、ウシエビなどの汽水養殖とコイ類、ナマズ類、ティラピア類などの淡水養殖の生産量が近年めざましい増加を示している。例えば1978年と1990年を比較すると、海水養殖(すべてハイガイ養殖)生産量は55,600トン(養殖総生産量の98%)から33,900トン(71%)に減少し、汽水養殖は0トン(0%)から5,100トン(11%)、淡水養殖は1,400トン(2%)から8,300トン(18%)に増加している。このような変化に伴って養殖生産額は増加し、総生産額は1978年の11,622千ドルから1990年の45,437千ドルに上昇し、海水養殖生産額は総生産額の86%から10%に減少する一方、汽水養殖は0%から47%に、淡水養殖は14%から43%に増加している。

現在の海水養殖の主体はハイガイ Anadara granosa (blood cockle, 俗称アカガイ)の地まき養殖で、ミドリイガイ Perna viridis (green mussel)の垂下養殖も一部で行われている。その他試験的に養殖が試みられているものとしては、マングローブガキ Crassostrea spp. がある。

汽水養殖には、アカメ Lates calcarifer (seabass, 日本のアカメとは別種)、ハタ類 Epinephelus spp. (groupers)、フエダイ類 Lutjanus spp. などの海産魚類の網

生簀養殖と、ウシエビ *Penaeus monodon* (black tiger shrimp) の池中養殖がある。

海産魚の養殖は天然種苗を用いたハタ、フエダイの養殖から始まったが、最初に産業的レベルに達したのはアカメ養殖である。ここでは種苗生産を含め養殖技術は確立しているが、隣国のタイから安価な種苗を輸入している養殖場が少なくない。現在ブームになりつつあるのは高級魚ハタ類（主体はチャイロマルハタとヤイトハタ）の養殖で、製品の多くは活魚としてホンコン、シンガポールなどに輸出される。未だに種苗生産技術が確立されておらず、種苗供給の制約のため養殖生産量は多くはない。

ウシエビを主体とする養殖は1980年代に急発展し、現在生産量は約8,000トン、養殖池面積は約2,000ha、(開発許可済みのサイトを加えると約5,000ha)、経営体数は約800となっている。この生産規模は近隣のタイ、インドネシア、フィリピンなどに比べるとはるかに小さい。全国に孵化場が40～45あり、種苗生産の技術は確立されている。池中養殖の養殖期間は4～6ヵ月、生産性は粗放的方式で0.5～1トン/ha/回、半集約的養殖では2～3トン/ha/回である。エビ養殖、特に種苗生産技術の発展には、1981年に設立され、1985年に日本の無償資金協力によって拡充、整備された国立エビ種苗生産研究センターが貢献するところが大きかった。ここでは、エビ種苗生産についての研究、生産した種苗の配布、民間への技術指導のほか、アフリカ、中近東、近隣諸国から研修員を受け入れて集団研修コースを運営している。

淡水養殖はほとんどすべて池中養殖の形態をとり、淡水魚類が全生産の約98%、オニテナガエビなどが約2%を占めている。魚類では、過去にはジャワカープ *Puntius gonionotus*、コイ *Cyprinus carpio*、ソウギョ *Ctenopharyngodon idella*、コクレン *Aristichthys nobilis* など東南アジアで伝統的なコイ科の養殖種が多かったが、最近ではレッドティラピア *Oreochromis niloticus* (カワスズメ科) の生産がトップとなり、その他ではミスタス *Mystus* spp. (ギギ科) やアフリカ産のヒレナマズ *Clarias gariepinus* (ヒレナマズ科) などのナマズ類、マーブルゴビー *Oxyeleotris marmoratus* (ハゼ科) などの養殖開発が進み、コイ科ではジャラワット *Leptobarbus hoeveni* などが有望な養殖種となっている。ソウギョ、コクレンの養殖形態は、養殖池や錫鉱石掘削跡池 (ex-mining pool) での施肥による粗放混養あるいはアヒルとの複合養殖であるが、ナマズ類などの養殖では大量給餌による集約的方式がとられている。

前述のように、マレーシアの養殖は歴史が新しく、生産量も大きくなく、工業化と先端技術指向の国策の中で漁業が占める地位も高くない。しかし漁業の中では遠洋漁業開発とともに養殖振興が比較的高い優先度を与えられていること、所得向上にともなう高級水産物の需要の増加が見込まれることから、養殖産業は発展の可能性を十分

にもっている。

この国の養殖はこれまで西（半島）マレーシアが中心であったが、近年ではサバ州での養殖開発がめざましく、淡水魚の生産はすでに西マレーシアに匹敵する水準に達しており、輸出をめざした高級海産魚とエビの生産量の増加も著しい。

(2) 問題点と将来展望

2020年に先進国入りをめざすマレーシアでは、社会、経済インフラは比較的よく整備されており、その面では養殖発展を阻害する重大な要因はない。しかし、エビ養殖では先発のタイ、インドネシアとの競合が激しく、またマングローブなど沿岸環境の保護の問題や第一次産業に対する政府の政策もあって、今後生産規模を短期間に急増させることはかなり困難と思われる。

一方、ハタなど高級海産魚の養殖は今後も市場拡大の可能性が大きい。ここで問題となるのは、安定種苗供給をはかるための種苗生産技術の確立であるが、これには従来の実学的飼育試験から一歩進んだより基礎的、生物学的な研究が必要となる。

現在、マレーシア農科大学では海洋水産学部拡充計画アフターケアでこの分野の協力が行われている。

8-2 スリ・ランカ

(1) 養殖の現状

スリ・ランカでは伝統的に水産物に対する嗜好性が強く、現在でも動物性たん白質の約65%を水産物に依存している。この国の国家開発計画では食料生産部門が重視されており、したがって水産分野の開発にも重点が置かれている。スリ・ランカの水産業は、刺網や曳縄、延縄などによる沿岸零細漁業が中心であるが、沿岸漁業では資源枯渇が問題となっている。そのため、漁港、保蔵施設の整備を含めた遠洋漁業の開発と養殖の振興に期待がかけられている。

スリ・ランカの水産養殖は、国内各所に存在する一般にタンクと呼ばれる貯水池に稚魚を放流して粗放的に養成する淡水魚養殖から始まった。魚種はカトラ *Catla catla*, ロフー *Labeo rohita*, ムリガル *Cirrhina mrigala* などのインドゴイとナイルティラピア *Oreochromis niloticus*, モザンビークティラピア *O. mossambicus* などのシクリッド類が主である。淡水魚養殖は一時はかなり普及し、かつて漁業省（現在漁業水産資源省）はボロンを中心に13カ所に養殖試験施設を持っていた。しかし、1989年から1993年までの政府の政策変更で2カ所を除いて民間に払い下げられ、急進的な仏教僧による殺生反対も絡んで、発展は停滞した。今後、政府としては年間養殖生産目標約4万トンのうちの5,000~6,000トン淡水魚養殖からあげる計画である。その

他の魚種としては、観賞熱帯魚の生産が進められており、国立水産資源局（NARA）でも観賞魚養殖部を設けて研究を行っている。しかし、その活動状況を見るかぎり、早急に発展するものとは思えない。

淡水魚に始まったスリ・ランカの養殖は、エビの汽水養殖やラグーンを利用した海産魚、貝類の養殖の振興に向かいつつある。

1985年に開始されたエビ養殖はウシエビを対象とし、現在の生産量は1,400トン、養殖池面積は1,250ha、経営体数175、従業者数3,500人となっている。養殖場には、海外の技術、資本を導入した大規模養殖場（調査団が見学した養殖場は総面積200ha、池面積100ha）と家内労働的な零細養殖場に分けることができる。大規模養殖場は北西部のチラウを中心に約10ヵ所ある。種苗生産施設は6ヵ所あり、生産技術は確立されている。エビ養殖開発に対する政府の支援は1991年から停止していたが、1994年から再開された。現在では前記の大規模業者が周辺の小規模業者に対し種苗配布や技術指導を行うなど、養殖普及の核としての機能を果たしている。

エビ以外の汽水、海水養殖としては、ミルクフィッシュ Chanos chanos の池中養殖がわずかながら行われている。その他では、ラグーンでのハタ類、アカメなどの魚類の網生簀、池中養殖、ミドリイガイ、ハイガイ類、オゴノリ Gracilaria sp. の養殖が計画されており、NARAではそのための生態調査や水質環境調査といった基礎研究に取り組んでいるが、養殖事業はいずれも未着手である。

スリ・ランカの主要な養殖研究機関は前述のNARAで、コロンボの本部のほかにカルピティア、トリンコマリ、ニゴンボなどにステーションがあり、45名の研究員を擁して海水養殖、品質管理、加工などの研究を行っている。養殖関連の研究員には17名の博士号取得者がいる。高等教育機関としては、ルフナ大学ほか1大学に水産学科がある。

(2) 問題点と将来展望

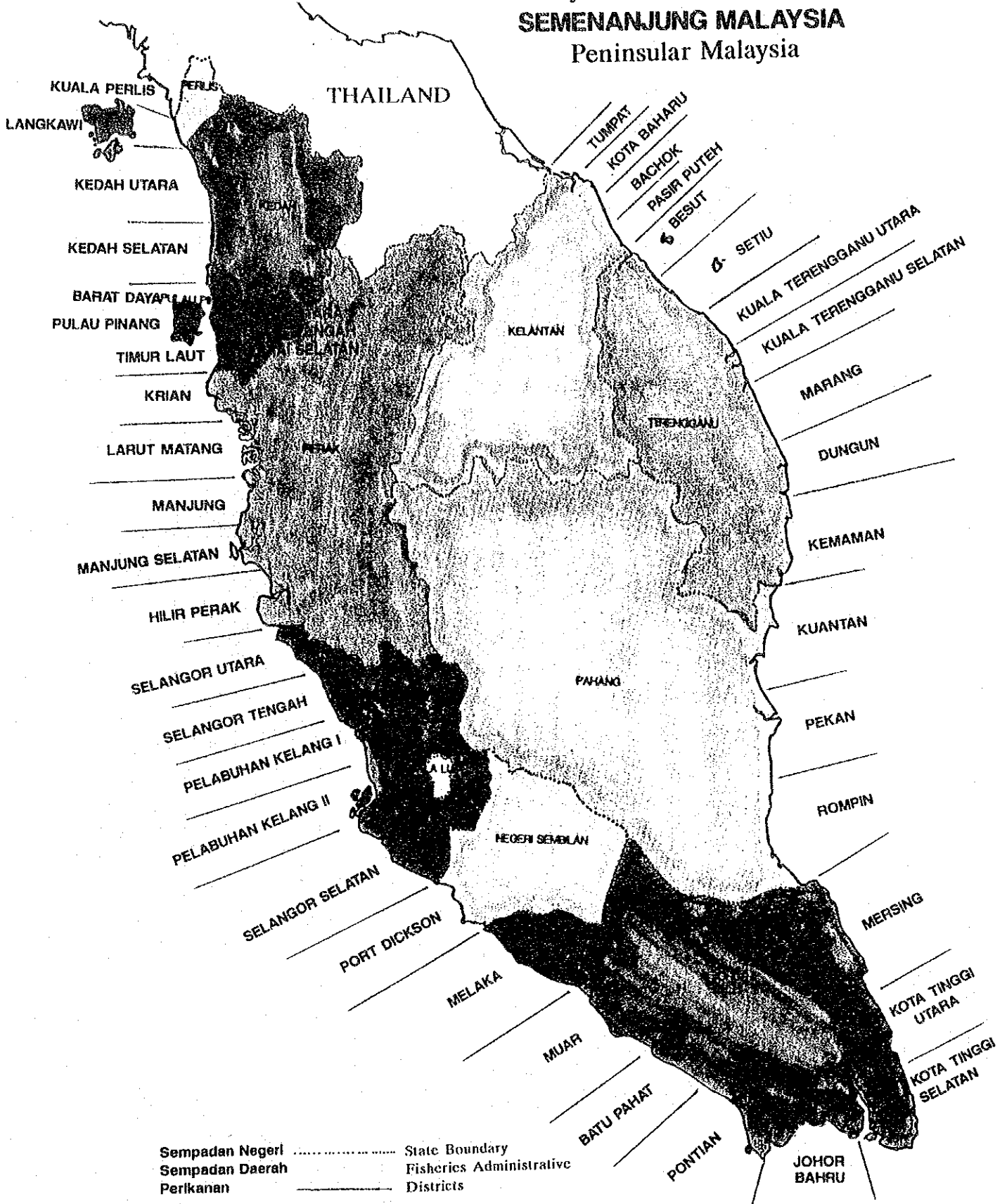
スリ・ランカの養殖発達を阻害する要因としては、道路網や保蔵冷凍施設などの基盤の不備と、政治的不安定性に起因する大きな政策のぶれがある。このあたりの環境が好転すれば、国民の嗜好と国土の地理的、地形的条件からみて、養殖が発展する可能性は十分にある。ただし、現在のエビ養殖をみると、知識、技術情報すべての面で大規模養殖企業と零細養殖業者の格差は非常に大きいものと見受けられた。淡水養殖をも含めて、今後この国の養殖を健全に発達させるためには、専門技術者の養成と民間零細業者の教育が必要である。また、エビ養殖でみれば、市場性のある製品をつくること、そのための情報収集の手段を構築すること、そしてそれに要する資金の問題を解決することが、発展のための大きな要素となるであろう。

MALAYSIA - DAERAH-DAERAH PERIKANAN

Malaysia - Fisheries Districts

SEMENANJUNG MALAYSIA

Peninsular Malaysia



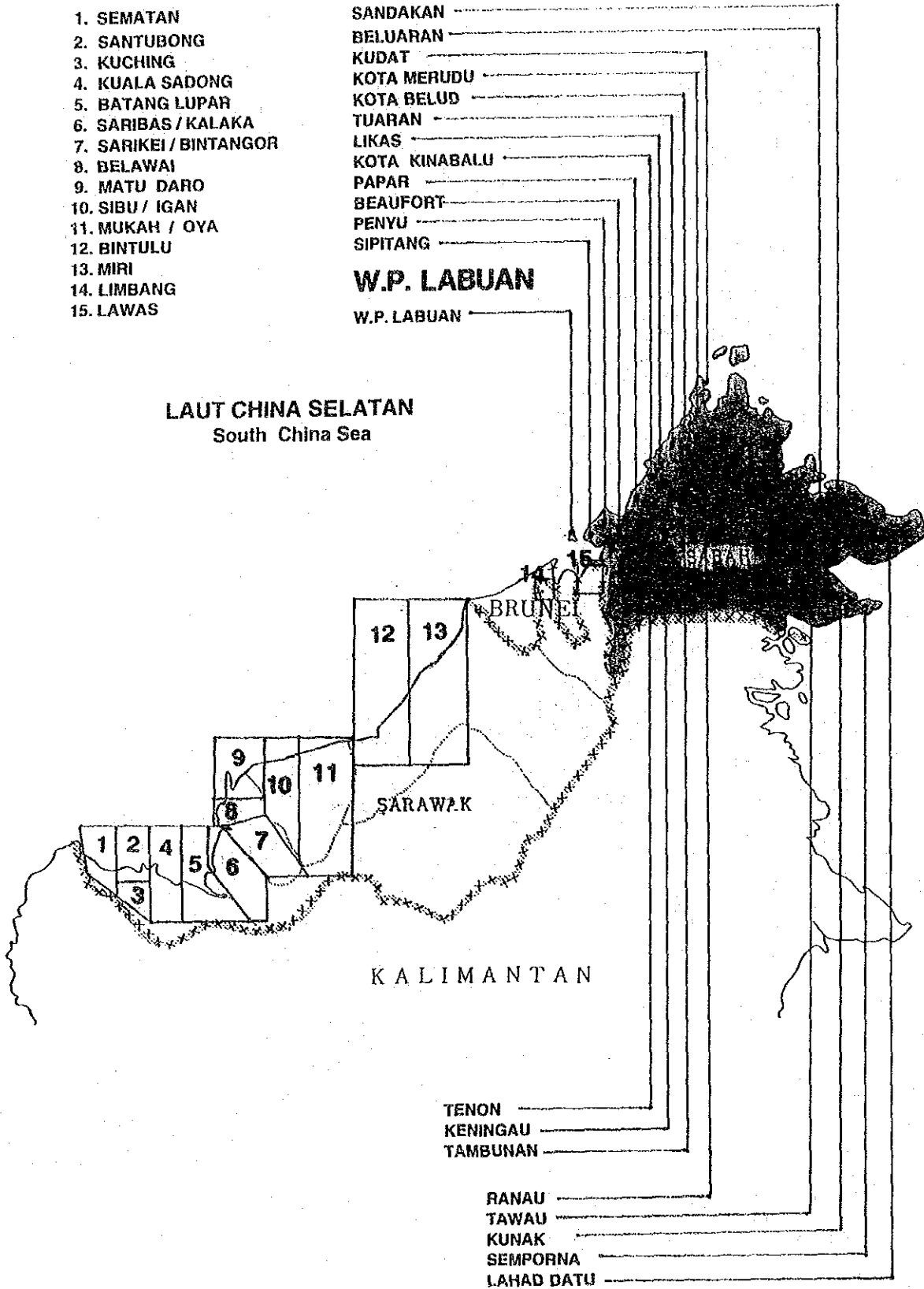
SARAWAK

1. SEMATAN
2. SANTUBONG
3. KUCHING
4. KUALA SADONG
5. BATANG LUPAR
6. SARIBAS / KALAKA
7. SARIKEI / BINTANGOR
8. BELAWAI
9. MATU DARO
10. SIBU / IGAN
11. MUKAH / OYA
12. BINTULU
13. MIRI
14. LIMBANG
15. LAWAS

SABAH

- SANDAKAN
 - BELUARAN
 - KUDAT
 - KOTA MERUDU
 - KOTA BELUD
 - TUARAN
 - LIKAS
 - KOTA KINABALU
 - PAPAR
 - BEAUFORT
 - PENYU
 - SIPITANG
- ### W.P. LABUAN
- W.P. LABUAN

LAUT CHINA SELATAN
South China Sea



TENON
KENINGAU
TAMBUNAN

RANAU
TAWAU
KUNAK
SEMPORNA
LAHAD DATU

STATUS OF THE FISHERIES SECTOR IN MALAYSIA

1. INTRODUCTION

1.1 The fishing industry plays an increasingly important role in the Malaysian economy. The fisheries sector contribution to the GDP has increased by 0.20% since 1991. It contributed 1.76% to the GDP in 1992 as compared to 1.56% in 1991. In 1992, the total fish landing from the fisheries sector amount to 1,104,988 tonnes valued at RM2.60 billion compared to 1991 where the fish landing from the fisheries sector total up to 978,235 tonnes valued at RM2.03 billion.

1.2 Basically the fisheries sector in Malaysia can be divided into Marine Fisheries, Aquaculture and Public Waterbodies/Inland Fisheries. The total landing from marine capture fisheries increased by 12.24% from 911,933 tonnes in 1991 to 1,023,516 tonnes in 1992. In terms of value, there was an increase of 28.44% from RM1.85 billion in 1991 to RM2.38 billion in 1992. Meanwhile, the total production of aquaculture, excluding ornamental fish production also increased by 22.91% from 64,843.63 tonnes in 1991 to 79,698.66 tonnes in 1992. In terms of value, there was an increase of 25.56% from RM165.15 million in 1991 to RM207.36 million in 1992. The ornamental fish production increased by 15.82% from 88,584,841 pieces in 1991 to 102,597,493 pieces in 1992. In terms of value, there was an increase of 20.13% from RM14.50 million in 1991 to RM17.42 million in 1992. The Public Waterbodies/Inland Fisheries produced 1,773.36 tonnes of fish in 1992 compared to 1,458.23 tonnes in 1991. This is an increase of 21.61% in production.

2. EMPLOYMENT (MANPOWER)

2.1 A total of 85,085 fishermen were engaged in the marine fisheries sector in 1992 compared to 84,862 fishermen in 1991, thus showing an increase of 0.26%. There was a decrease in the total number of fishermen from Peninsular Malaysia by 1.47% (from 61,309 fishermen to 60,410 fishermen). However, Perlis, Pahang and East Johore showed an increase in the number of fishermen by 3.75%, 2.36% and 5.23% respectively. Meanwhile, Sabah showed a significant increase of 6.67% (from 16,133

6. AQUACULTURE

6.1 Basically, the aquaculture industry in Malaysia comprises freshwater and brackishwater culture. Freshwater culture is carried out in freshwater ponds, freshwater cages and ex-mining pools. On the other hand, brackishwater culture covers brackishwater ponds, brackishwater cages and mollusc culture comprising of cockles, mussels and oysters culture.

6.2 Freshwater Culture

6.2.1 The total production of freshwater culture increased by 44.22% from 11,088.79 tonnes in 1991 to 15,991.93 tonnes in 1992. In terms of value, there was an increase of 45.18% from RM71.81 million in 1991 to RM104.25 million in 1992. Freshwater culture contributed 20.07% of the total aquaculture production in 1992. The increase in the freshwater production in 1992 was contributed by 3 factors i.e. the increase in the area of freshwater pond, fresh water cages and ex-mining pools, increase in the average production of freshwater pond to 28.43% due to the change for better quality feed i.e. pelleted/commercial feed and a better market prospect compared to 1991.

6.2.2 Freshwater pond culture production was the highest in 1992, contributing 88.56% (14,162.35 tonnes) followed by production from ex-mining pool contributing 8.42% (1346.07 tonnes) and production from cages contributing 3.02% (483.51 tonnes) of the total freshwater culture production. A total of 15,591 culturists were involved in the freshwater pond culture covering an area of 5,598.09 hectare, 281 culturists involved in the freshwater culture in the ex-mining pools covering an area of 1,059.22 hectare and 321 culturists involved in the freshwater cage culture covering an area of 29,046.42 metre square.

6.2.3 The production of eel has shown tremendous increase in 1992 i.e. a 3 times increase compared to 1991 although its contribution to the total production of freshwater pond culture was only 11.0% in 1992. Eel production increased from 442.51 tonnes in 1991 to 1,572.00 tonnes in 1992. The increase in eel production came from the fact that there was a good foreign market demand in 1992 compared to 1991.

6.2.4 The 3 main species cultured in freshwater ponds were black tilapia producing 21.23% (3006.26 tonnes) followed by javanese carp producing 17.51% (2480.33 tonnes) and common carp producing 11.96% (1693.78 tonnes). The 3 species showed similar importance in term of production in 1991 and 1992. The average production for

freshwater pond increased from 1.97 tonnes/hectar/year in 1991 to 2.53 tonnes/hectar/year in 1992.

6.2.5 The total production increased by 41.85% (from 948.93 tonnes in 1991 to 1,346.07 tonnes in 1992). However, average production for freshwater culture in ex-mining pool decreased from 1.47 tonnes/hectar/year in 1991 to 1.27 tonnes/hectar/year in 1992. The 3 main species cultured in 1992 were big head carp producing 931.75 tonnes, grass carp producing 156.86 tonnes and red tilapia producing 88.34 tonnes. It was observed that there was a decrease in percentage of production of red tilapia by 57.99% from 210.8 tonnes in 1991 to 88.34 tonnes in 1992. This was because many of the culturist who were culturing red tilapia in ex-mining pool started culturing it in freshwater cages as the case in Selangor.

6.2.6 In terms of average production of freshwater cage culture there was a decrease from 23.32 kilogram/meter square/year in 1991 to 16.65 kilogram/meter/year in 1992. The total production decreased by 15.76 % from 573.97 tonnes in 1991 to 483.51 tonnes in 1992, although in terms of area, there was an increase from 24,613.37 meter square in 1991 to 29,046.42 meter square in 1992. This was because in 1992 a number of the cages has not been operational. Johor and Terengganu recorded a drop in average production of freshwater cages due to the above reason. Red tilapia was the main species cultured which constituted 70.29% of the total species cultured with production of 339.87 tonnes.

6.3 Brackishwater Culture

6.3.1 The number of culturists involved in brackishwater pond culture were 646 with an area of culture of 1,702.91 hectare while the number of culturists involved in brackishwater cage culture were 1,013 with an area of culture 397,799.36 meter square. The number of culturists involved in cockle culture were 291 with an area of culture of 4,316.13 hectare. The number of culturists involved in mussel culture were 215 with area of culture of 46,963.76 meter square and the number of culturists involved in oyster culture were 97 with an area of culture of 36,249.21 meter square.

6.3.2 The total production of brackishwater culture increased by 18.51% from 53,754.84 tonnes in 1991 to 63,706.73 tonnes in 1992. The increase in production came from cockles and fish from brackishwater cages while others like brackishwater pond, mussel and oyster culture, the production decreased. The cockle production increased by

19.22% and fish from brackishwater cages by 58.15% while others, like brackishwater pond, mussel and oyster culture, the production decreased by 5.81%. The production of cockle increased in 1992 due to increase in enforcement in combating the smuggling of cockle seed abroad. A number of ponds in Johore ceased in operation in 1992 and this caused the decrease in the production of brackishwater pond culture. While the decrease in the production of mussel was due to the problem of seeds where there was a decrease in the natural occurrence of mussel seed. This is obvious in Johor, the main producer of mussel seeds. The same case happened in Selangor and Perak. In Perak a number of mussel culture operation were closed down due to the problem of barnacles which destroyed the seed. Oyster too faced the problem of seed supply from Perak and Terengganu.

6.3.3 In terms of value, there was an increase of 10.34% (from RM93.45 million in 1991 to RM103.11 million in 1992).

6.3.4 Cockle culture production was the highest amongst the brackishwater culture production in 1992 contributing 87.25% (55,586.84 tonnes) of the total production of brackishwater culture. While, the brackishwater cage culture contributed 5.29% (3,369.35 tonnes), brackishwater pond culture 5.06% (3,224.55 tonnes), mussel 2.35% (1,493.40 tonnes) and oyster 0.05% (32.95 tonnes). However, in terms of value, brackishwater pond culture contributed the highest i.e 49.88% (RM51.43 million) followed by brackishwater cage culture 35.10% (RM36.19 million), cockles 14.10% (RM14.54 million), mussels 0.61% (RM629,230) and oyster 0.31% (RM324,320).

6.3.5 The main species cultured in brackishwater pond was tiger prawn producing 87.39% (2,818.04 tonnes) of the total production of brackishwater pond. Other species cultured were banana prawn, barramundi, mangrove snapper, grouper, mudcrab and other miscellaneous species which comprised 12.61% (406.51 tonnes) of the total production of the brackishwater pond. It was observed that, barramundi species cultured dropped by 80.51% (from 192.89 tonnes in 1991 to 37.59 tonnes in 1992) while grouper dropped by 96.79% (from 38.29 tonnes in 1991 to 1.23 tonnes in 1992). The drop is due to the decrease in demand for the species cultured in ponds compared to the ones cultured in cages. The main states that produced fish cultured in pond were Selangor, Perak and Johore. Kedah also has started fish culture in pond and showing some encouraging development.

6.3.6 The 3 main species cultured in brackishwater cages were barramundi, contributing 81.52% (2,746.67 tonnes) followed by grouper contributing 8.51% (286.57 tonnes) and mangrove snapper contributing 7.81% (263.05 tonnes). The total production of brackishwater cage culture increased by 58.15% (from 2,130.48 tonnes in 1991 to 3,369.35 tonnes in 1992), while average production also increased from 7.06 kilogram/meter square/year in 1991 to 8.47 kilogram/meter square/year in 1992. The total production of brackishwater cage culture, was shown to increase in Kedah by 332.08% (from 11.13 tonnes in 1991 to 48.09 tonnes in 1992), Penang by 75.64% (from 538.20 tonnes in 1991 to 945.31 tonnes in 1992), Perak by 218.98% (from 179.17 tonnes in 1991 to 571.52 tonnes in 1992) and Johore by 47.25% (from 372.37 tonnes in 1991 to 548.32 tonnes in 1992). There was no production for Sarawak in 1991. However, in 1992, Sarawak showed a production of 45.00 tonnes.

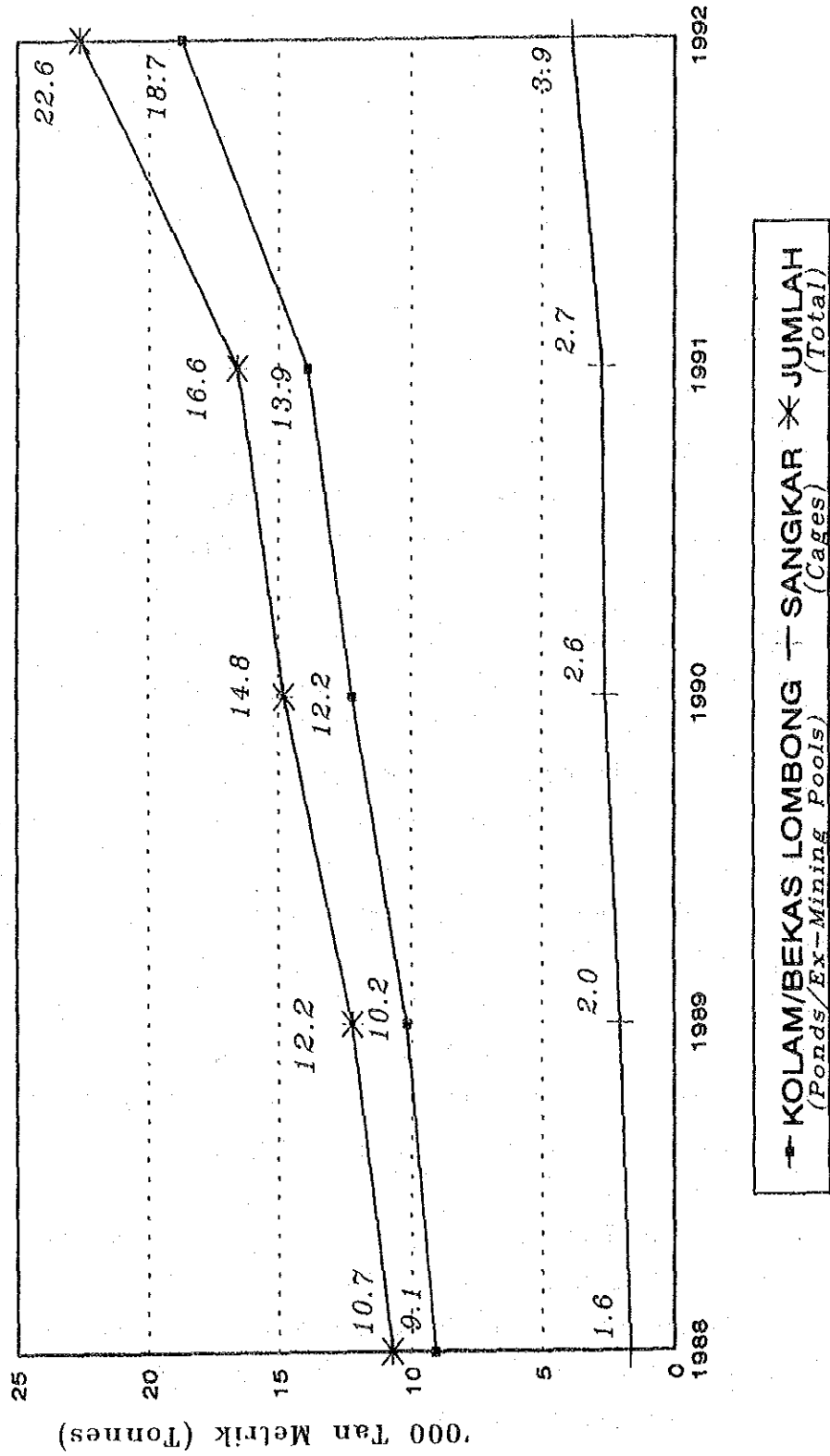
6.4 Ornamental Fish

6.4.1 The total production of ornamental fish increased by 15.82% from 88,584,841 pieces in 1991 to 102,597,493 pieces in 1992. In terms of value, the increase was 20.13% (from RM14.5 million in 1991 to RM17.42 million in 1992). In terms of production by states, Penang production increased by 235.83% (from 3,052,037 pieces in 1991 to 10,249,489 pieces in 1992), Perak increased by 1,669.99% (from 1,159,241 pieces in 1991 to 20,518,472 pieces in 1992) and Selangor increased by 1082.40% (from 867,696 pieces in 1991 to 10,259,646 pieces in 1992). Johore remained as the main producer of ornamental fish contributing 61,529,206 pieces which was 59.97% of the total producer of ornamental fish in 1992. The 2 main group of Family produced were Cyprinids contributing 47.31% (gold fish and Japanese carp 28.62%, Barb and Danio 18.69%) and Poecilids contributing 21.77% of the total production of the ornamental fish.

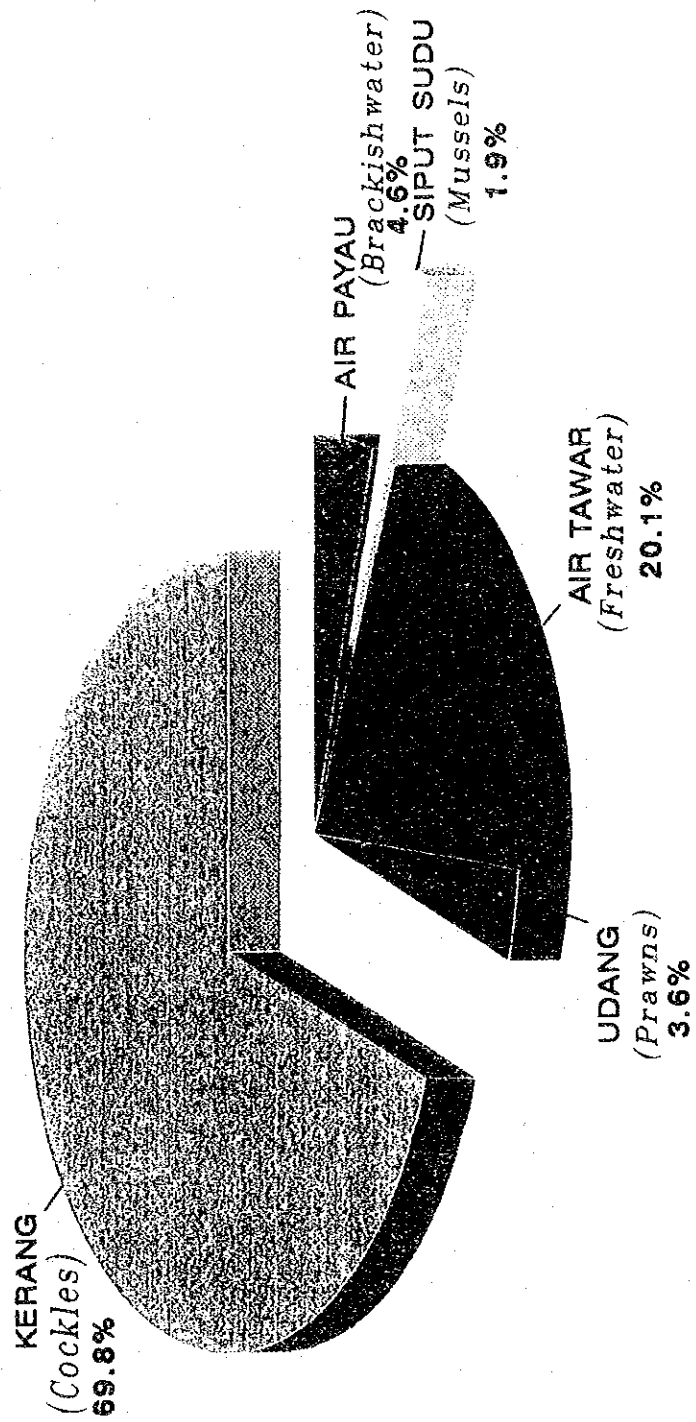
7. PUBLIC WATERBODIES/INLAND FISHERIES

7.1 Public Waterbodies/Inland Fisheries refers to the production of fish from public waterbodies resources i.e. river, lakes, ex-mining pools and dams. The landing of Public Waterbodies/Inland Fisheries increased by 21.61% from 1,458.23 m.t in 1991 to 1,773.36 m.t in 1992. Kedah, Perak, Johor, Pahang, Terengganu and Kelantan showed an increase in landing by 56.53%, 28.74%, 31.54%, 0.73%, 19.31% and 9.69% respectively. The increase in production was the result of the success of the program on the release of fish fry to the public water bodies and the enforcement of the Fisheries (Riverine) Rules in a number of states.

MALAYSIA
ARAH ALIRAN PENGELUARAN TERNAKAIK, 1988-1992
(Trend Of Aquaculture Production, 1988-1992)



MALAYSIA
PENGELUARAN TERNAKAIR MENGIKUT JENIS TERNAKAN, 1992
(Production Of Aquaculture By Type Of Culture , 1992)



MALAYSIA
ANGGARAN BILANGAN DAN LUAS KOLAM, BEKAS LOMBONG DAN SANGKAR YANG DIUSAHAKAN
SERTA BILANGAN PENTERNAK MENGIKUT SISTEM TERNAKAN DAN NEGERI 1992
ESTIMATED NUMBER AND AREA OF PONDS, DISUSED MINING POOLS AND CAGES
AND NUMBER OF CULTURISTS BY CULTURE SYSTEM AND STATE, 1992

JADUAL (TABLE) 13.1

Negeri/ State	Airtawar/Freshwater						Airpayau/Brackishwater						Jumlah/Total									
	Kolam Pond			Bekas Lombong Disused Mining Pools			Sangkar Cages			Kolam Ponds			Sangkar Cages			Kolam & Bekas Lombong Ponds & Disused Mining Pools			Sangkar Cages			
	Bil. No.	Luas (ha) Area (ha)	Bil. Pentermak No. Of Culturists	Bil. No.	Luas (ha) Area (ha)	Bil. Pentermak No. Of Culturists	Bil. No.	Luas (m ²) Area (m ²)	Bil. Pentermak No. Of Culturists	Bil. No.	Luas (ha) Area (ha)	Bil. Pentermak No. Of Culturists	Bil. No.	Luas (m ²) Area (m ²)	Bil. Pentermak No. Of Culturists	Bil. No.	Luas (ha) Area (ha)	Bil. Pentermak No. Of Culturists	Bil. No.	Luas (m ²) Area (m ²)	Bil. Pentermak No. Of Culturists	
Perlis	75	14.73	63	0	0.00	0	0.00	0	5	2.80	83	0	0	17.53	80	68	0	0	0.00	0	0.00	0
Kedah	1,007	239.02	519	3	6.25	3	0.00	0	222	121.22	83	0	0	366.49	1,232	605	1,405	12,590.00	12,590.00	90	90	
Pulau Pinang/Penang	232	30.14	153	0	0.00	0	0.00	0	41	23.84	5	11,944	75,227.40	231	273	158	11,844	75,227.40	75,227.40	231	231	
Perak	2,217	557.47	1,546	199	628.43	181	358	3,460.37	43	214	51	15,159	122,035.00	184	2,630	1,778	15,517	125,495.37	125,495.37	227	227	
Selangor	1,884	304.96	1,500	100	172.34	69	1,126	18,416.88	22	117	47	7,031	90,518.03	139	2,101	1,616	8,157	108,934.91	108,934.91	161	161	
N.Sembilan	1,758	316.00	1,449	21	39.20	21	157	1,338.37	4	36	3	16	148.64	6	1,815	1,473	173	1,487.01	1,487.01	10	10	
Malaka/Malacca	1,070	211.34	857	0	0.00	0	59	532.16	8	14	8	68	631.72	8	1,084	865	127	1,163.88	1,163.88	16	16	
Johor/Johore	1,592	220.46	726	0	0.00	0	128	1,991.86	19	759	131	4,507	65,595.06	175	2,351	857	4,635	67,586.92	67,586.92	194	194	
Pahang	2,893	2,049.33	1,402	7	213.00	7	197	2,110.18	159	30	17	38	889.60	2	2,930	1,426	235	2,999.78	2,999.78	161	161	
Terengganu	765	93.85	581	0	0.00	0	67	596.60	14	107	58	840	8,277.40	30	872	639	907	8,974.00	8,974.00	44	44	
Kelantan	1,475	177.12	1,007	0	0.00	0	0	0.00	0	133	45.77	41	304	11,986.51	1,608	1,068	304	11,986.51	11,986.51	70	70	
Sarawak	1,614	266.47	1,379	0	0.00	0	60	600.00	52	87	66	40	400.00	31	1,701	1,445	100	1,000.00	1,000.00	83	83	
Sabah	9,894	1,117.20	4,409	0	0.00	0	0	0.00	0	669	446.28	131	936	9,400.00	10,563	4,540	936	9,400.00	9,400.00	47	47	
Jumlah/Total:	26,476	5,598.09	15,591	330	1,059.22	281	2,152	29,046.42	321	2,434	646	42,188	397,799.36	1,013	29,240	16,518	44,340	426,845.78	426,845.78	1,334	1,334	

Note: Bagi Sarawak, ia merujuk kepada kolam yang telah dibina dalam tahun semasa.
 Note: For Sarawak it refers to ponds constructed during the current year.

JADUAL (TABLE) 14.2

MALAYSIA
 ANGGARAN NILAI BORONG IKAN TERNAKAN, KERANG, SIPUT SUDU DAN TRAM
 MENGIKUT NEGERI DAN SISTEM TERNAKAN, 1992
 ESTIMATED WHOLESALE VALUE OF FISH, COCKLES, MUSSELS AND OYSTERS
 BY STATE AND CULTURE SYSTEM, 1992
 (Nilai Dalam RM '000/Value in RM '000)

Negeri State	Airtawar/Freshwater			Airpayau/Brackishwater			Jumlah (RM)/Total (RM)				Jumlah Besar Grand Total		
	Kolam Ponds	Bekas Lombong Ex-Mining Pools	Sangkar Cages	Kolam Ponds	Sangkar Cages	Kerang Cockles	Kerang Cockles	Siput Mussels	Siput Mussels	Oysters		Oysters	
Perlis	34.21	0.00	0.00	61.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	96.00	
Kedah	714.52	14.73	0.00	6,985.32	709.30	26.74	7.57	32.50	7,714.57	709.30	26.74	7.57	8,490.68
P.Pinang/Penang	165.25	0.00	0.00	1,701.71	12,503.16	3,044.57	0.00	0.00	1,866.96	12,503.16	3,044.57	0.00	17,414.69
Perak	4,299.09	2,491.66	125.17	4,791.90	6,500.39	9,549.28	11.10	46.50	11,582.65	6,625.56	9,549.28	11.10	27,815.09
Selangor	2,927.71	369.67	1,212.37	9,345.92	10,168.24	1,731.52	3.92	0.00	12,643.30	11,380.61	1,731.52	3.92	25,759.35
N. Sembilan	1,405.58	114.58	125.68	457.85	0.00	0.00	5.49	0.00	1,978.01	125.68	0.00	5.49	2,109.18
Malaka/Malacca	1,544.87	0.00	26.61	164.98	0.00	0.00	56.30	0.00	1,709.85	26.61	0.00	56.30	1,792.76
Johor/Johore	2,266.20	0.00	43.88	9,389.59	5,427.43	172.93	520.30	0.00	11,655.79	5,471.31	172.93	520.30	17,820.33
Pahang	24,206.76	236.85	1,816.71	2,656.46	8.10	14.75	2.76	0.00	27,100.07	1,824.81	14.75	2.76	28,942.39
Terengganu	609.47	0.00	13.59	603.60	53.22	0.00	107.35	0.00	1,213.07	66.81	0.00	107.35	1,387.23
Kelantan	1,315.42	0.00	0.00	1,088.34	86.28	0.00	20.52	137.97	2,403.76	86.28	0.00	20.52	2,648.53
Sarawak	6,560.46	0.00	39.00	1,584.00	733.00	0.00	1.27	0.00	8,144.46	772.00	0.00	1.27	8,917.73
Sabah	51,568.68	0.00	0.00	12,600.00	0.00	0.00	0.00	0.00	64,168.68	0.00	0.00	0.00	64,168.68
Jumlah/Total:	97,618.22	3,227.49	3,403.01	51,431.46	36,189.12	14,539.79	629.23	324.32	152,277.17	39,592.13	14,539.79	629.23	207,362.64

JADUAL (TABLE) 14.1

MALAYSIA
 ANGGARAN JUMLAH PENGELUARAN IKAN TERNAKAN, KERANG SIPUT SUDU DAN TIRAM
 MENGIKUT NEGERI DAN SISTEM TERNAKAN, 1992
 ESTIMATED PRODUCTIONS OF FISH, COCKLES, MUSSELS AND OYSTERS
 BY STATE AND CULTURE SYSTEM, 1992
 (Kuantiti Dalam Tan Metric/Quantity in Tonnes)

Negeri State	Airtawar/Freshwater				Airpayau/Brackishwater				Jumlah Kacil/Sub-total				Jumlah Besar Grand Total Tan M. Tonnes		
	Kalam Ponds	B.Lombong/ Ex-Mining Pools	Sangkar Cages		Kalam Ponds	Sangkar Cages	Kerang Cockle	Siput Sudu Mussels	Tiram Oyster	B.Lombong/ Ex-Mining Pools/Ponds	Sangkar Cages	Kerang Cockle		Siput Sudu Mussels	Tiram Oyster
Petis	10.75	0.00	0.00	5.50	0.00	0.00	0.00	0.00	16.25	0.00	0.00	0.00	0.00	0.00	16.25
Kedah	241.41	5.80	0.00	438.82	89.14	48.09	10.82	2.60	686.03	48.09	89.14	10.82	2.60	836.68	
P.Pinang/Penang	40.99	0.00	0.00	199.83	945.31	945.31	0.00	0.00	240.82	945.31	9,821.20	0.00	0.00	11,007.33	
Perak	1,014.60	1,036.91	27.27	273.82	571.52	38,197.11	17.08	3.72	2,325.33	598.79	38,197.11	17.08	3.72	41,142.03	
Selangor	628.22	208.86	319.69	511.69	1,194.01	6,926.06	3.56	0.00	1,348.77	1,513.70	6,926.06	3.56	0.00	9,792.09	
N. Sembilan	341.28	35.28	32.90	28.01	0.00	0.00	6.87	0.00	404.57	32.90	0.00	6.87	0.00	444.34	
Malaka/Malacca	405.77	0.00	6.26	9.32	0.00	0.00	140.77	0.00	415.09	6.26	0.00	140.77	0.00	562.12	
Johor/Johore	359.35	0.00	10.60	476.68	548.32	508.63	1,238.81	0.00	836.03	558.92	508.63	1,238.81	0.00	3,142.39	
Pahang	1,964.22	59.22	76.62	165.73	0.90	44.70	4.60	0.00	2,189.17	77.52	44.70	4.60	0.00	2,315.99	
Terengganu	140.77	0.00	3.67	42.46	6.43	0.00	0.00	11.30	183.23	10.10	0.00	0.00	11.30	204.63	
Kelantan	301.09	0.00	0.00	73.69	9.77	0.00	68.41	15.33	374.78	9.77	0.00	68.41	15.33	468.29	
Sarawak	1,627.90	0.00	6.50	99.00	45.00	0.00	2.12	0.00	1,726.90	51.50	0.00	2.12	0.00	1,780.52	
Sabah	7,086.00	0.00	0.00	900.00	0.00	0.00	0.00	0.00	7,986.00	0.00	0.00	0.00	0.00	7,986.00	
Jumlah/Total	14,162.35	1,346.07	483.51	3,224.55	3,369.35	55,586.84	1,493.04	32.95	18,732.97	3,852.86	55,586.84	1,493.04	32.95	79,698.66	

JADUAL (TABLE) 22.2

MALAYSIA
 HARGA RUNCIT IKAN AIRTAWAR DI PASAR-PASAR UTAMA MENGIKUT
 NEGERI DAN SPESIES IKAN, 1992
 RETAIL PRICES OF FRESHWATER FISH AT MAJOR MARKETS
 BY STATE AND FISH SPECIES, 1992
 (RM/KG)

Negeri State	Lampam Jawa Javanese Carp	Lee Koh Common Carp	Kap Rumput Grass Carp	Kap Kepala Besar Big Head Carp	Tilapia Hitam Black Tilapia	Tilapia Merah Red Tilapia	Udang Galah Giant Fresh- water Praun	Keli Freshwater Catfish	Kerutu Goby	Jelawat River Carp	Belut Eel	Pelbagai Miscellaneous
Perlis	0.00	3.80	0.00	3.65	3.50	4.80	0.00	5.00	16.10	8.10	0.00	4.50
Kedah	3.21	3.75	0.00	3.25	3.70	3.83	17.00	4.16	14.00	10.90	0.00	2.00
P. Pinang/Penang	3.00	2.80	0.00	0.00	0.00	5.00	21.00	4.41	0.00	12.00	0.00	4.00
Perak	4.03	4.85	5.40	2.92	4.46	5.05	19.00	5.42	21.30	9.50	0.00	4.50
Selangor	5.44	6.00	4.15	2.10	4.53	4.97	16.62	5.40	30.00	11.25	0.00	1.40
N. Sembilan	4.80	4.91	4.80	5.00	4.25	5.12	16.50	5.90	28.00	8.00	0.00	6.06
Melaka/Malacca	4.35	3.50	4.33	1.85	3.00	5.16	20.00	4.62	27.50	10.00	0.00	6.00
Johor/Johore	4.75	4.16	5.66	5.25	3.25	5.35	18.00	5.16	25.16	9.75	0.00	6.52
Pahang	5.05	4.50	5.00	5.00	4.90	5.62	18.16	6.36	28.16	38.63	14.00	4.73
Terengganu	4.75	4.58	5.00	5.00	4.71	5.41	12.50	5.00	17.50	7.87	0.00	3.72
Kelantan	4.35	5.70	5.26	4.62	4.33	5.50	15.62	5.12	16.50	8.66	0.00	5.11
Sarawak	5.00	3.50	3.50	3.20	2.80	8.00	0.00	0.00	8.00	6.80	0.00	4.50
Sabah	7.00	12.00	12.00	8.00	7.67	0.00	0.00	0.00	0.00	0.00	0.00	7.00
Harga Berimbang Weighted Price	6.29	10.59	5.50	2.40	7.25	5.04	18.20	4.97	26.86	9.70	14.00	5.71

Nota: Pelbagai - Termasuk ikan-ikan, Haruan, Baung dan Sepat Siam
 Note: Miscellaneous - Includes, Snake Head, River Catfish and Snakekin Gouramy

MALAYSIA
 BILANGAN DAN PENGELOJARAN PUSAT PENGELOJARAN BENIH IKAN/UDANG SWASTA
 MENGIKUT NEGERI, 1992
 NUMBER AND PRODUCTION OF PRIVATE FISH/PRAWN FRY HATCHERY CENTRE
 BY STATE, 1992

Negeri State	Bilangan Numbers	Pengeluaran (Juta Ekor) Production (Million Pieces)	
		Benih Udang Prawn Fry	Benih ikan Fish Fry
Perlis	0	0	0
Kedah	14	15.35	9.15
P. Pinang/Penang	1	24	0
Perak	10	54	1.36
Selangor	5	NA	0.12
Wilayah Persekutuan Kuala Lumpur	2	NA	NA
Negeri Sembilan	0	0	0
Malaka/Malacca	3	3.9	1.6
Johor/Johore	19	297	0
Pahang	0	0	0
Terengganu	4	3260	0.48
Kelantan	0	0	0
Sarawak	1	6	0
Sabah	0	0	0
Jumlah	59	3660.25	12.71

Nota : NA - Tiada Maklumat
 Note: NA - Not Available

ANGGARAN PENGELUARAN IKAN AIR TAWAR DAN NILAI DI SABAH, TAHUN 1982-1991.
 Estimated Production of Freshwater fish And Values in Sabah, For the Year 1982-1991.

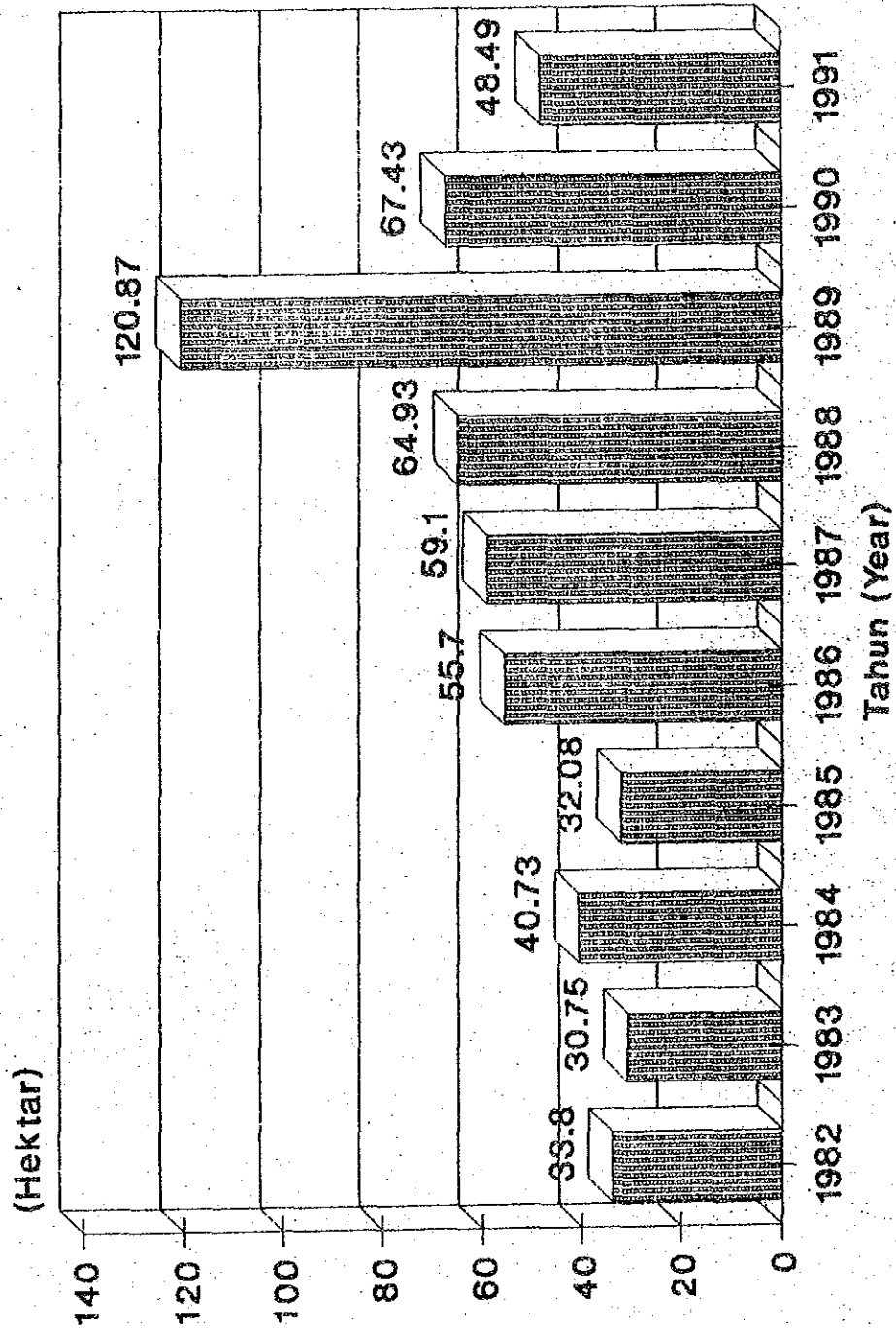
Tahun	Pengeluaran/Production		Kuantiti (Tan. M) Quantity (Tonnes)	Nilai Borong (\$'000) Whole-Sale (\$'000)	
	Kolam Air Tawar Fresh Water Ponds	Lain-Lain Others			
1982	1,700	500	2,200	8,000	
1983	1,900	600	2,500	11,400	
1984	2,100	700	2,800	14,000	
1985	2,200	700	2,900	15,000	
1986	2,400	700	3,100	17,000	
1987	3,000	800	3,800	21,000	
1988	3,300	800	4,100	25,000	
1989	3,700	1,000	4,700	29,000	
1990	4,000	1,200	5,200	33,300	
1991	4,823	1,400	6,223	47,976	

BIBIT - BIBIT IKAN DI BEKALKAN OLEH SETIAP STESEN PEMBIAKAN, SABAH 1991.
Fish Fry Supplied By Breeding Station, Sabah 1991.

(Unit: Ekor)

NO.	STESEN PEMBIAKAN Breeding Station	NILE BREAM Nile Bream	LAMPAM JAWA Javaness Carp	KAP BIASA Common Carp	KALUI Giant Gouramy	LAIN-LAIN		JUMLAH Total
						Others	Others	
1	Babagon, Penampang	234,820	141,077	56,983	-	10,256		443,136
2	Kebayau, Kota Belud	52,880	56,270	45,837	-	518		155,505
3	Bingkor, Keningau	156,428	13,879	6,270	8	-		176,585
4	Marakau, Ranau	159,053	12	28,412	-	-		187,477
5	Gum- Gum, Sandakan	258,481	5,567	1,146	-	1,660		266,854
6	Telupid	60,385	6,533	6,771	504	4		74,197
7	Jimangan, Beaufort	108,271	20,370	52,867	-	-		181,508
JUMLAH Total		1,030,318	243,708	198,286	512	12438		1,485,262

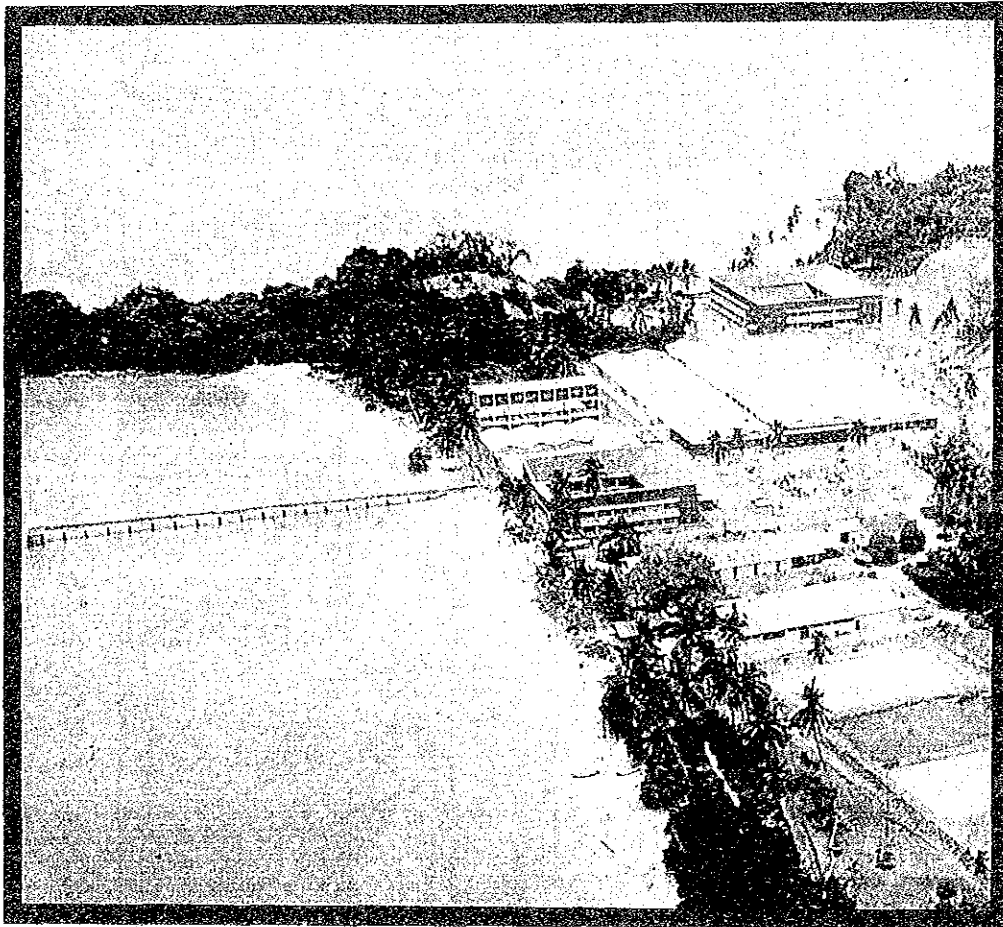
PEMBINAAN KOLAM IKAN AIR TAWAR DI SABAH, 1982 - 1991
Freshwater Fish Ponds Built In Sabah, 1982 - 1991



**PUSAT
PENGELUARAN & PENYELIDIKAN
BENIH UDANG KEBANGSAAN**

**National Prawn Fry
Production & Research Centre**

**KG. PULAU SAYAK
KEDAH DARULAMAN**



**Jabatan Perikanan
Kementerian Pertanian Malaysia,
50628 Kuala Lumpur.**

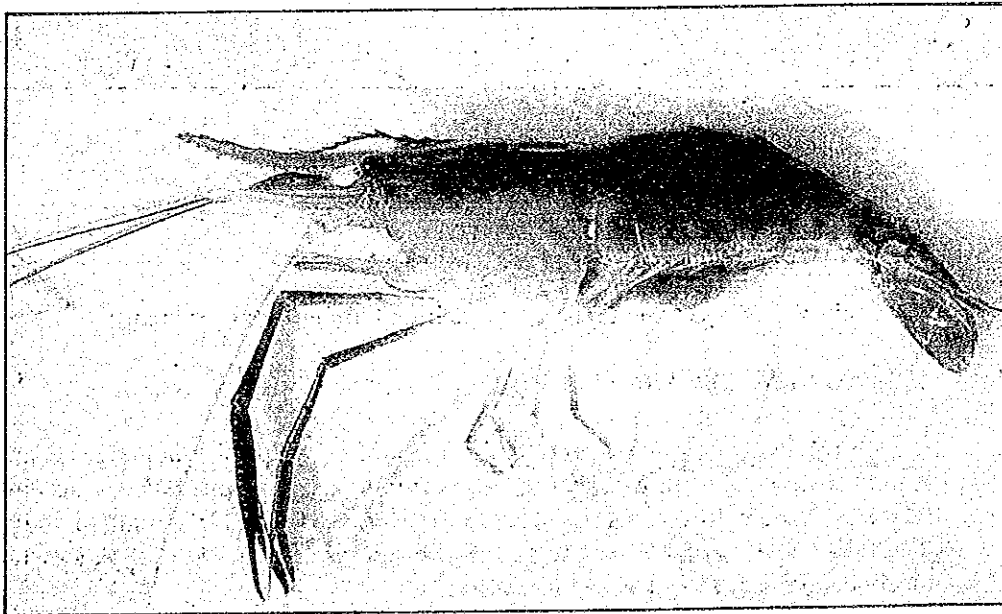
BACKGROUND

The National Prawn Fry Production and Research Centre started its operation in 1981. It was then an Extension Centre primarily concerned with the fry production of the Giant Malaysian Freshwater Prawn (*Macrobrachium resenbergii*) to meet the demand of local farmers. However, the rapid pace of development of the prawn culture industry in the country lately particularly the progress in the culture of the Tiger Prawn (*Penaeus mondon*) has necessitated the expansion of the Centre and the widening of its scope to provide for better infrastructure and facilities to cater for the need of the industry. The Centre was transferred to the Research Branch with its Headquarters in Penang to reflect its new role.

OBJECTIVES

The major objectives of the centre are:-

- i Mass production of the prawn fry, an annual production target of 60 million fry including 55 million marine prawn fry and 5 million Giant Malaysian Freshwater Prawn fry has been set.
- ii To carry out research in hatchery technology for the mass production of prawn fry to result in the development of practicable production system which could be adopted by the private sector.
- iii. To provide training in all aspects of brackishwater aquaculture to existing and potential investors both from the private and public sectors.



ROLES

To encourage the development of the prawn culture industry, the Centre provide free supply of prawn fry to small scale farmers who carry out culture for the first time. Fry produced are also sold to aquafarmers to meet the ever increasing demand for such fry in the country. However most of the fry produced by the Centre are released into rivers (Giant Malaysian Freshwater Prawn) and the coastal waters (marine prawn) under the public water stocking programme initiated by the Department of Fisheries. It is envisaged that such efforts will lead to the enhancement of fisheries resources of our waters and hence resulting in better catches for the fishermen. Already the Centre has been receiving encouraging feedback from the present effort.

ACTIVITIES OF THE CENTRE

The activities are planned to meet the objectives stated above. They may be classified under three major categories:-

1. PRODUCTION

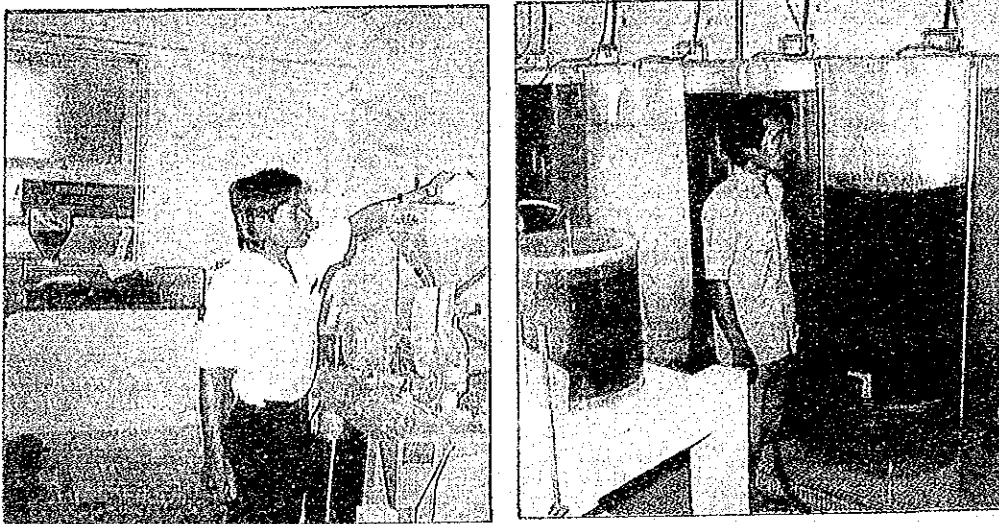
To meet the production target of 60 million fry a year various production systems are adopted. These include the extensive, semi intensive and the intensive culture systems. The different systems require different level of technical competency and facilities. The various systems can be adopted by private hatcheries for commercial fry production.



2. RESEARCH

The major objective of research is to develop and improve existing hatchery technology for mass production of fry to improve productivity and economic profitability. The research programme is formulated to meet such objective. The major research projects are listed below:-

- i. Studies of various hatchery systems to further improve their efficiency and cost effectiveness.
- ii. Maturation studies to overcome the problem of shortage of spawners.
- iii. Studies of larval feed and nutrition in an attempt to develop artificial feed which can finally reduce/replace the use of live feed such as plankton and artemia nauplii.
- iv. Pathological studies for disease prevention and control so as to result in higher survival rate and success of larviculture.
- v. Water quality studies to determine the optimal requirement for larviculture and also to develop a practicable and cost effective water treatment process.



3. TRAINING

The Centre will be developed into the national centre for brackishwater aquaculture training in the country. The courses presently offered include the following:

Name Of Course	Duration
* Marine Prawn Hatchery	4 weeks
* Giant Malaysian Freshwater Prawn Hatchery	8 weeks
* Brackishwater Aquaculture	9 days
* Cage Culture	6 days
* Mussel Culture	4 days
* In Service Training For Department Staff	1 — 4 weeks

The training Block can accommodate up to 60 trainees at any time, and up to three courses may be conducted simultaneously. The courses offered have so far been well received from people both from the private and public sectors. The number of certain courses need in fact to be increased to meet the overwhelming response.

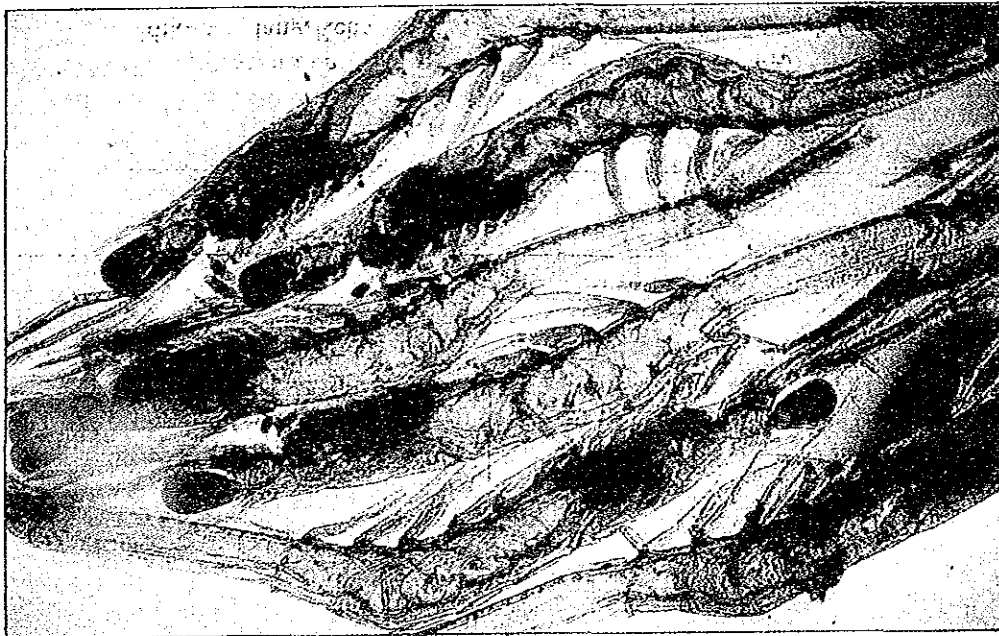
It is hoped that the provision of such courses may act as a catalyst in aquaculture development in the country leading to greater aquaculture production and also higher income for the farmers.



ACHIEVEMENT

Various production systems with different degree of sophistication has been tested out in the Centre. With the adoption of such systems, the Centre has been able to achieve its annual production target of 60 million fry in its very first year of operation. The Centre is also able to overcome the problem of shortage of gravid females by eyestalk ablation technique. The technique of eyestalk ablation has been passed on to private hatcheries so that they can also depend on non gravid females, which can be found in greater abundance, for spawning purposes. In the field of training close to three hundred potential and practising aquaculturists, department staff and staff from other government agencies have been trained in various aspects of brackishwater aquaculture in the very first year of operation. It is envisaged that from then onwards, the Centre can train up to 600 people in a year.

The Centre will continue to carry out mass fry production mostly for open water stocking programme to increase the prawn resources of our waters. There will also be constant effort to improve the existing hatchery technology to render them more cost effective and fool proof.



NATIONAL FISHERIES DEVELOPMENT PLAN

1990 - 1994

Ministry of Fisheries & Aquatic Resources

Sri Lanka

Fisheries Development Plan

Chapter 1

1. Fishing Industry - An Overview

- 1.1 Sri Lanka is situated in the Indian Ocean to the South of India between latitudes 6 - 10 degrees North and longitudes 80 - 82 degrees East. The island has a land area of approximately 66000(1) sq. km, and a coastline of 1561 km. in length. Since the declaration of the Exclusive Economic Zone in 1978 Sri Lanka has sovereign rights over 233,000 sq. km of the Ocean.
- 1.2 Marine fishing in the country takes place all round the coast but is mainly confined to the continental shelf area which is rather narrow, it rarely exceeds 40 km and averages around 22 km in width. The total area of the shelf is about 26000 sq. km which is around 11% total area of the EEZ of Sri Lanka.
- 1.3 The freshwater fisheries potential of Sri Lanka consists of nearly 162,500 ha. covering large medium and small perennial tanks (including the new reservoirs within the Mahaweli Systems) and around 100,000 ha. of village tanks and villus. The brackishwater potential covers 120000 ha. of lagoons, rivers estuaries, mangrove swamps and salt marshes.
- 1.4 The fishery sector in Sri Lanka is important in the economy of the country due to the following reasons:-
 - 1.4.1 It contributes a substantial portion of the animal protein consumed by the

population. According to the Food Balance Sheet (Dept. of Census and Statistics) fish contributed 65% of the animal protein consumed in Sri Lanka in the year 1988.

- 1.4.2 The fishing industry provides full time employment to around 96,000 persons (according to the Fisheries Survey of 1989) part time employment is also provided to around 10,000 persons while a further 5000 people are provided indirect employment by the industry.
- 1.4.3 The industry contributed 1.9% to the Gross Domestic Product (GDP) of Sri Lanka in 1988 (Central Bank Report 1988).
- 1.4.4 Exports of fish and aquatic products contributed on an average Rs. 616 m in foreign exchange in 1986 - 1987. This was 2.8% of the total non-traditional export earnings of the country. In 1988 the total export earnings were Rs. 825 million.
- 1.5 The bulk of fish production in 1988 came from the coastal fishery which employed around 80,000 persons. The fishing fleet of Sri Lanka in 1988 consisted of around 28,000 vessels of which 13,000 or 46% were motorized.
- 1.6 The breakdown of the marine fishing fleet by major type of craft in 1989 was as follows

1.9 The annual supply per capita of fish in Sri Lanka increased from 11.34 kg. in 1978 to 15.75 kg. in 1983 and thereafter fell to 14.61 kg. in 1986. If this is considered as being equivalent to the per capita consumption of fish, Sri Lanka is still way below developed countries such as Japan and Norway but favourably well placed with developing countries.

1.10 Most of the domestic production of fish in Sri Lanka is consumed in wet form while around 12% - 15% of the marine fish landings and about 25% of inland fish landings are dried prior to sale. Over 60% of the coastal fish catch is moved out of the producer areas in wet form by road/rail. The major wholesale fish markets are in Colombo and Kandy. Ice is used for preservation and transport while there is very little freezing done for local sales.

1.11 The overall development promotion and management of fisheries have been the responsibility of a separate Ministry since 1971. At present this responsibility lies with the Ministry of Fisheries & Aquatic Resources. The Ministry directly engages itself with the formulation of plans, policies and strategies for all areas and subjects relating to fisheries and aquatic resources. In this it is assisted by two divisions viz. Planning Division and Development Division. The implementation of development plans, projects and management measures are undertaken by a Department of Fisheries which has a network of field officers island-wide. The training of fisheries manpower is undertaken by the National Institute of Fisheries Training (NIFT).

1.12 The Ministry has three statutory bodies. viz. The Ceylon Fisheries Corporation, The Ceylon Fishery Harbours Corporation and the National Aquatic Resources Agency (NARA). The first two have been set up by Incorporation Orders within the framework of the State In-

dustrial Corporation Act of 1959 while the National Aquatic Resources Agency (NARA) has been set up under a separate Act of Parliament (National Aquatic Resources Research and Development Agency Act of 1981). In addition, Cey-Nor Development Foundation which originated as a NGO is now functioning as a public company under the supervision of the Ministry of Fisheries and Aquatic Resources.

1.12.1 Ceylon Fisheries Corporation (CFC)

Ceylon Fisheries Corporation buys and sells fish in competition with private traders and in this process tries to regulate the fish prices in a manner designed to help the producer and the consumer.

1.12.2 Ceylon Fishery Harbours Corporation (CFHC)

Ceylon Fishery Harbours Corporation is responsible for the servicing of fishery harbours and shore facilities which support the fishing industry.

1.12.3 National Aquatic Resources Agency (NARA)

National Aquatic Resources Agency is the research arm of the Ministry and undertakes and co-ordinates research activities relating to fisheries and aquatic resources.

1.12.4 The Cey-Nor Development Foundation Ltd.,

The Cey-Nor Foundation Ltd., is a state owned company engaged in the building of boats and in the manufacture of fishing gear and nets.

1.13 Private sector is the dominant force in the operation of fishing crafts. Except for around 500 boats which are owned by co-operative societies the rest are privately owned.

Chapter 2

2. Objectives of the National Fisheries Development Plan

2.1 Government Party Manifesto

This National Fisheries Development Plan covers the five year period 1990 - 1994 and has been formulated based on the Policy Manifesto of the Government Party. The Government Party Manifesto in regard to fisheries reads as follows:-

2.1 "We will make Sri Lanka self-sufficient in fisheries.

2.1.2 The role of the National Aquatic Resources Agency will be enhanced, so that it could play a more effective short and long-term role in the development of aquatic resources.

2.1.3 Infrastructure facilities and improvements to the fishery industry will be provided as necessary."

2.2 Based on the Party manifesto, the Ministry of Policy Planning and Implementation has indicated the basic tenets of fisheries development as follows:-

2.2.1 Adopt measures to expand appropriate mechanization and fishing gear.

2.2.2 Set up organizations of poor fishermen and fisherwomen.

2.2.3 Incorporate training, credit, land, housing and other community services in fisheries development programmes.

2.2.4 Provide necessary infrastructure facilities and improvements to fishing industry.

2.2.5 Develop a programme for self-sufficiency in fisheries.

2.2.6 Take steps to diversify into non-traditional produce such as aquatic foliage for export.

2.3 Objectives of the Plan

In keeping with the policies set out in the Government Party manifesto the objectives of this National Fisheries Development Plan are as follows:-

2.3.1 To increase the production of fish in order to increase the nutritional status of the people of Sri Lanka through a higher per capita consumption of fish.

2.3.2 To promote the rational and optimum exploitation of Sri Lanka's fisheries and aquatic resources based on the application of modern science and technology.

2.3.3 To support the national programme for Alleviation of Poverty by increasing the incomes and standards of living of all those dependent on fisheries and fisheries related activities.

2.3.4 To increase employment opportunities through fisheries and fisheries related activities.

2.3.5 To increase the foreign exchange earnings through exports of fisheries and aquatic products.

Chapter 3

3. Goals and Targets of Fisheries Development:

3.1 To ensure that the above indicated objectives will be achieved during the period 1990-1994, this Plan lays down a series of goals and targets. These have been determined taking into consideration a series of factors among which are the following:-

3.1.1 The biological, land and water resources which are the principal determinants of production from capture as well as culture fisheries.

3.1.2 The protein requirements of the population based on minimum stipulated levels.

3.1.3 The current status of the fishing fleet and its capabilities.

3.1.4 The services and facilities required to support the fishing industry.

3.1.5 The needs of the fishing families and communities.

3.2 Resources

3.2.1 Marine Resources

Marine fish resources in Sri Lanka are, for management purposes classified under 2 areas viz.

Coastal - from the shore upto the edge of the continental shelf.

Offshore - from the edge of the continental shelf to the 200 nautical miles Exclusive Economic Zone.

The principal marine fish resources are within the continental shelf and the annual sustainable yield within the continental shelf is estimated by "Fridjof Nansen" Surveys at 250,000 m. tons consisting of 170,000 m. tons of pelagic and 80,000 m. tons of demersal and semi-demersal fish. The main pelagic fish species available in the coastal zone are small pelagics such as sardines, Indian mackerel, and herrings and the large pelagics such as Spanish mackerel, tuna and tuna like fish, barracudas or pampanos. The demersal species include prawns,

silver bellies, moon fishes, ribbon fishes and large demersals, such as breams, groupers and snappers.

The offshore Fishery exploits resources beyond the edge of the continental shelf to the outer limit of EEZ and beyond. The resources are mainly migratory tuna such as yellow fin and skipjack and species such as sharks, marlin, swordfish and sail fish. In the early seventies the annual sustainable yield from the offshore and deep sea was estimated at 29,000 m. tons. A recent estimate based on the results of exploratory surveys indicate a potential yield between 70,000 - 90,000 m. tons of migratory pelagic fish from the offshore area within the Exclusive Economic Zone of Sri Lanka.

3.2.2 Inland Fisheries

There are approximately 162,500 ha. of perennial freshwater bodies, over 100,000 ha. of small seasonal tanks and around 120,000 ha. of lagoons, estuaries and swamps. The most important freshwater bodies from the fish production angle are the major irrigation reservoirs. Seasonal tanks are a recently identified resource with great potential for fish culture. In addition, large extents of land mostly adjacent to lagoons have been identified as being suitable for coastal aquaculture mainly, shrimp culture.

3.3 Fish demand projections

The Medical Research Institute has indicated that an average per capita consumption of 60 grams of fish a day would be a consumption level to be aimed at. On this basis, the per capita consumption per year would amount to 21.0 kg. However, for the purpose of this Plan a lower demand projection has been worked out at the rate of 17.52 kg. per capita for 1990 which is 80% the MRI rate. This is still almost 10% over and above the average per capita availability of fish during the past decade. It has been assumed that per capita consumption would increase gradually during the planned period to reach 18.0 kg. in 1994.

Table 10**Targets for Export of Fish and Aquatic Products (Value Rs. M.)**

Item	1990	1991	1992	1993	1994
Prawns - Capt	471.0	581.0	570.0	627.0	690.0
Cult	720.0	810.0	900.0	1044.0	1252.0
Lobsters	119.0	125.0	131.0	137.0	144.0
Crabs	27.0	27.0	27.0	27.0	27.0
Aquarium Fish	80.0	95.0	110.0	138.0	172.0
Mis. Products	124.0	124.0	124.0	124.0	124.0
Total	1541.0	1762.0	1862.0	2097.0	2409.0

Note:

1992. However it is very likely that these may have to be revised taking into consideration the performances in 1989 and the progress in the implementation of the prawn culture and other projects.

The National Aquatic Resources Agency (NARA) is the research arm of the Ministry. In accordance with the Party Manifesto "the role of NARA will be enhanced, so that it could play a more effective short and long term role in the development of aquatic resources" during the plan period NARA has a wide mandate and its objectives are as follows:

- (a) To ensure the application and utilization of scientific and technological expertise for the implementation of the national development programme on the subject of aquatic resources:
- (b) To promote and conduct research activities directed towards the identification, assessment, management and development of aquatic resources and particularly in the following fields:-
 - i) Oceanography.
 - ii) Improvement and development of fishing craft, fishing gear and equipment, and fishing methods.
 - iii) The social and economic aspects of the fishing industry, including the welfare of fishermen and their dependents.
 - iv) The processing, preservation and marketing of fish and related products.
 - v) The development, management and conservation of aquatic resources in the inland waters, coastal wetlands and off-shore areas.
- (c) To provide advisory and consultancy services on scientific, technological and legal matters relating to the exploitation, management and development of aquatic resources.
- (d) To coordinate the activities of institutions engaged in the exploitation planning, research, development, control and management of aquatic resources.
- (e) To undertake the collection, dissemination and publication of information and data useful for the development of aquatic resources and the fishing industry in Sri Lanka.
- (f) To provide training for persons required to carry out or assist in the work of the Agency and

- (g) To exercise, discharge and perform all the powers, functions, and duties conferred or imposed on the Agency under this Act.

NARA will undertake a series of research activities during the Plan period to support the development programmes in fisheries sector. This calls for several different disciplines such as marine biology, fresh-water and brackishwater biology and aquaculture, oceanography and hydrography, fishing technology and post harvest fish technology as well as environmental studies for all of which separate divisions or units have been established within NARA. During the Plan period this research effort will be financially and technically supported by at least two major foreign-funded projects viz. the FRG funded project for hydrographic studies and the UNDP funded project for Marine Research.

In regard to marine fisheries NARA's regular programme will encompass the following which have been identified to be of high priority.

1. Provide conclusions in relation to resource availability by respective geographical areas (e.g. Southern, North Western etc.) and by broad species groups based on already available data and findings.
2. Formulate a programme for the optimum utilization of the fisheries potential of the lagoons and estuaries.
3. Make available to the fishermen in local language basic oceanographic and hydrographic data already collected by NARA and compiled in the form of fisheries charts.
4. To utilize the fisheries charts to carry out fishing trials to identify new fishing grounds particularly for bottom trawling and identify currently underutilized or unutilized areas and species of fish.
5. To introduce the use of high resolution remote sensing imagery (Spot, Mos, Landsat) to obtain data on fishing oceanographic of near-shore areas useful to fishermen and publish them in the form of charts.
6. Provide guidance for diversifying the fishery by introducing/promotioning new fishing methods/gear based on the fisheries charts already prepared and oceanographic studies conducted by NARA upto now.

7. Carry out an islandwide survey of fishing gear and craft and prepare an inventory of craft and gear.
8. Publish in local languages the major findings of its deep sea fishing surveys (eg. tuna survey).
9. Collect information on deep sea fishing using multiday vessels, foreign vessels either using log sheets or placing observers.

In regard to Inland Fisheries and Aquaculture the regular research activities will include the following which have been determined on the basis of current priorities.

1. Carry out stock assessment and classification of major inland reservoirs and suggest empirical models to determine optimal fishing effort suitable for such reservoirs.
2. Determination of the extent of hybridization of cichlid populations in reservoirs and to correlate the degree of hybridization to the production traits of the individual populations and to suggest management measures for the inland fisheries.
3. Develop suitable fishing gear and adopt suitable methods for harvesting of major Indian carps and other large sized fishes in the major reservoirs.
4. Carry out studies to develop suitable technology to utilize the vast areas of wet zone water logged lands for Aquaculture.
5. Develop techniques to breed both exotic and indigenous ornamental fish, which have hitherto not been bred in Sri Lanka under artificial conditions.
6. Carry out studies to develop integrated farming systems suitable for the country and carry out an evaluation of their economic and technical viability.
7. Development of local feeds that are cheaper in price and more suited to local condition in the development of small scale brackish water aquaculture.

As stated under Fisheries Training, Education and Extension, NARA will also play an active part in Training and Education. NARA's scientific and research personnel will participate in these activities by contributing in the formulation of curricular for

training courses and conducting lectures in respect of scientific subject areas. It will collaborate with the Training Division in all the formal training programmes with a scientific and technical content.

- Dissemination of research findings among the fishermen as well as the extension workers will be given due emphasis. The MAARIS Programme of NARA will assist in this work. NARA is also participating in the Fishersfolk Extension Programme which is funded by the UNDP and executed by the FAO and which aims at the institution of an effective and an appropriate cadre of extension workers both within and outside the public sector and develop a suitable mechanism for such extension effort.
- The establishment of regional centres will be continued during the Plan. The Centre for the Southern Coast will become operational in 1990 while the centres for the East and the North will be established in the early years of the Plan period. These centres in addition to functioning as the regional base for research activities will also undertake demonstration and training activities. They will be in close touch with the problems of a scientific and technical nature and keep them under constant review.
- The Institute of Post Harvest Technology of NARA will play an important role in the improvement of the quality of fish and fish products. This activity will be aimed at the following:-
 - Use of improved traditional methods of fish preservation such as sun-drying/pickling/smoking of fish.
 - Use of flexible packaging materials to prolong the storage life of products and facilitate the marketing of products in urban areas.
 - Training of the fishermen and transporters/traders in improved methods of handling fish including proper use of ice, packing and use of new containers.
 - Proper utilization of fish waste, by-catches, trash fish, less popular varieties of fish and other aquatic resources.
 - The promotion of low cost fish meal plants among the small scale fishermen, preferably cooperative societies under the Janasaviya Programme.

Implementation Ministry's statement we should take steps to diversify into non-traditional produce such as aquatic foliage etc. into export.

The targets in respect of exports of fisheries and aquatic products over the Plan period are indicated in Table 10. The paragraphs below discuss the policies and strategies to be followed in order to attain these targets.

At present, the export trade is dominated by prawns/shrimp. During the past seven years prawns on an average accounted for 54% of the total volume and 65% of the total value of exports. Though prawn will continue to remain as the most important single item of exports the diversification of the export base is necessary and will be aimed at.

Prawns:

In regard to prawn itself, the ratio of captured to cultured prawns needs to be changed. Upto 1985, all supplies of prawns exported from Sri Lanka came from capture fisheries. It is not possible to depend on the natural stocks to take advantage of the ever-expanding world demand which according to studies made by the EDB exceed the supply by 200,000 tons by the year 1990. Hence the culture prawns will have to be developed on a high priority basis. For this the following strategies and policies will be used:-

Expanding the area under brackishwater prawn culture by extending this activity (which is now concentrated in the NWP) to the Southern, Northern and Eastern areas. NARA is now carrying out a survey of land suitable for this activity and this will be completed in 1990 - 1991.

Provision of better scientific and research services for prevention of diseases.

Reducing the cost of prawn feed by developing cost-efficient feed.

Capture Prawn Fishery would be developed on the basis of new prawn grounds. NARA has commenced several studies in this direction.

Ornamental Fish:

Next to Prawns, Ornamental fish is the most important single item and this will be promoted during the Plan period. The marine products sub-sector report of the Export Development Plan states that "with correct planning, sufficient investments and satisfactory infrastructure facilities the turnover of ex-

ports in aquarium fish can reach the Rs. 1000 million mark by 1992.

Five constraints to the growth of this item has been identified. These are the

1. Supply of brood stock.
2. Technical & advisory services on the improvement of breeding technique and training.
3. Breeding of new high value species.
4. Reducing fish diseases and mortality developing low-cost and feed.

4.2 Implementation Schedule

The proposed strategies for increasing the production and export of ornamental fish would be as follows:-

- NARA will provide training in the breeding and rearing of ornamental fish in collaboration with the Ministry, the Mahaweli Economic Agency and the Export Development Board. The training will be targeted particularly to those who will be starting this activity under the Janasaviya Programme.
- The private sector will be encouraged to extend the on-going cluster farming scheme to other areas. Mahaweli Authority is providing land within its area for this purpose and the Ministry will in collaboration with the Provincial Councils assist the smaller farmers in other areas to obtain land. The bank will also extend assistance for ornamental fish farmers.
- Exporters will be encouraged to breed new species with a high export value and assistance will be given to import the brood stock. The existing assistance schemes of the Export Development Board will be extended to cover small scale exporters of ornamental fish.
- In regard to disease control and development of low cost feed NARA and the Inland Fisheries Division will carry out joint programmes. The institution of cost efficient quarantine systems will also be given high priority.

Export of Food Fin Fish:

Export of food fin fish has now been liberalized. Export prospects are bright for tunas (Skip-jack,

Yellow fin and big-eye tuna) and for demersal varieties such as snapper, grouper and pomfrets. CFC will make an active effort to emerge as a major exporter of these items making use of its cold room facilities.

Other products:

Beche-de-Mer,

Shark fins,

Lobsters, crab and cuttle fish and squid.

In regard to these items the major constraints to expansion is the lack of sufficient supplies. In the case of Beche-de-Mer new grounds will be surveyed by NARA. A further aspect which will be looked into by the institute of Fish Technology is the processing of this product to obtain a higher price. In the case of shark fins too export of processed product will be encouraged rather than the unprocessed.

In the case of lobsters and cuttlefish more effective and less harmful methods of exploitation will be experienced. Crab fattening and ultimately crab culture will also be promoted with foreign assistance if necessary.

Sea weed is an item which is particularly processing from the foreign exchange and employment point of view. The farming of sea weed Gracilaria used for Agar and Sargassum use for Alginic acid are also being tried at with a view to extension.

4.2 Implementation Schedule:

Implementation of the Planned activities can be primarily grouped under two categories, ie.

- Those which will have to be implemented at the National level primarily by the Ministry of Fisheries and Aquatic Resources in collaboration with other agencies.
- Those activities which have to be implemented at the provincial district and down to Grama Niladari level by the Provincial Councils, Pradeshiya Sabhas, Local Government Institutions and Grama Niladari level Organizations.

It does not need to be emphasized that the implementation capacity is primarily determined by the level of financial resources available. The plan proceeds on the basis that in regard to the first category, the financial resources will be available from the government in the form of budgetary allocations. These funds will come from the Consolidated Fund

or from external resources and will be supplemented with other available resources.

In the case of the second category of activities, most of the funds necessary are to be obtained from numerous sources at the local level which have the potential to support these activities. These include the decentralized budget and the allocations of the Hon. Members of Parliament, the funds of the Provincial Councils, the Pradeshiya Sabhas and the Local Government Institutions funds available for disbursement provincial/district or local level by various government agencies and institutions, non-governmental organisations and finally the resources available with the village level organisations. The identification and the harnessing of such resources will be done to ensure that optimum use is made of financial resources of varying magnitudes available with a large number of agencies and organisations. In addition, that will be undertaken by the Fisheries Co-operative Societies pertaining to construction of houses, roads, latrines, community centres etc. can be identified as another source of investment. The implementation schedule takes into consideration this possibility.

The approximate requirements of investment funds during the Plan Period are given in Section 4.3. It should be noted that these amounts are only indicative.

4.2.1 Category 1 - Development Activities to be implemented by the Ministry of Fisheries:

The development activities which are to be implemented by the Ministry of Fisheries relate to those which have to be implemented on a national scale. These are indicated in table and section relating to investments. Some of these programmes and activities have yet to be finalized and are indicated herein subject to the approvals which have to be obtained.

4.2.2 Category 2 - Development Activities which will be implemented at the local levels:

The activities which come under this category are province/district/village specific activities particularly, common amenities and settlements, as well as the infrastructure and production oriented facilities required relatively little investment. For reasons of both efficiency as well as economy these activities

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