

### III. 評価結果要約

#### 1. 目標達成度

	成果の達成度	プロジェクト目標達成を促進/阻害した要因
<p>(1)プロジェクトの各「成果」が「プロジェクト目標」達成につながった度合い</p>	<p><b>1. 資源増殖</b></p> <p><b>成果 1-1 安定的大量種苗生産手法の確立（種苗生産）</b>            C/P は基本的な量産技術をほぼ習得しているが、カニ種苗生産のための環境制御技術が未開発ではある。カニとヘタリの生産数量は目標値を下回ったが、エビ種苗生産が早期達成したことによりプロジェクト開始後2年目で終了となったことは特筆すべきである。</p> <p><b>成果 1-2 ハラショアでの適正な放流及び養殖手法の研究と、その手法の確立（ハラショア研究）</b>            C/P は養殖及び放流の試験計画を作成し、ハラショアでの適正な調査ができるようになり、その際の問題点を把握できるようになった。現在、十分なデータが得られていないが、放流魚の成長の追跡調査が可能となった。</p> <p><b>成果 1-3 適正な親養成手法の確立（親魚養成）</b>            C/P は、眼柄切除及び精官移植法による親エビの催熟試験を行えるなど、試験計画を作成して結果を把握し、問題点をある程度解決できるようになった。</p>	<p>・<b>促進要因</b>            海産エビ養殖実験場を建設(86年)し、91年から個別専門家を派遣した。</p> <p>・<b>阻害要因</b>            ハラショアでの養殖試験はハラショアオーナー側の管理体制に依存している。</p>
	<p><b>2. 沿岸環境調査</b></p> <p><b>成果 2 沿岸環境モニタリングシステムを構築する。</b>            沿岸環境モニタリングでは調査が定期的継続的に実施されること、また調査手法と得られたデータの信頼性が重要であるが、C/P は、各「活動」を実施することによりモニタリングができるようになった。</p>	<p>・<b>阻害要因</b>            プロジェクト開始後、EIA委員会の調査、会議の出席等の業務量増大に伴い、重金属及び残留農薬の定期調査が大幅に遅れた。</p>
	<p><b>3. 沿岸生態調査</b></p> <p><b>成果 3 沿岸生態研究及びモニタリング技術の方法を確立する。</b>            沿岸生物相・分布状況を把握のためのデータベース構築、沿岸生態系の効率的な影響調査、生物統計学の習得するによって C/P は自主的な調査・研究を行い、論文を作成した。            モニタリング調査を定期的継続的に実施することにより C/P は生態学的な知識・技術を習得し、例えば AFRC は西インド洋におけるサゴ礁研究の中核的機関になるものと推測される。</p>	<p>・<b>阻害要因</b>            C/P の事務業務の繁忙、出張及び留学により研究時間の確保が困難な面があった。</p> <p>・<b>促進要因</b>            モーリシャス政府による環境保全政策の推進。</p>

(1)プロジェクトの各「活動」が「成果」につながった度合い	成果の達成度	プロジェクト目標達成を促進/阻害した要因
	<p><b>1. 資源増殖</b></p> <p><b>1-1 アミメノキリガサミ、ヘグイ、ウシエビの研究開発の実施</b></p> <p>①アミメノキリガサミ:細菌症の予防研究、餌料生物の培養試験、適性餌料試験、適性飼育塩分濃度の試験を実施し、主な消耗要因の真菌症を防止し、餌料生物の安定培養を確立した。</p> <p>②ヘグイ:消耗要因であるウーテ・ニューム症の予防方法及び餌料系列を確立した。また、形態異常魚確認のための骨格染色を実施した。</p> <p>③ウシエビ:量産技術を達成し、プロジェクト開始後 2 年目で終了した。</p> <p><b>1-2-1 アミメノキリガサミ、ヘグイ、ウシエビの放流技術の開発</b></p> <p>①アミメノキリガサミ: 中間育成時の餌料系列を確立し、中間育成後パラショアへ放流した。</p> <p>②ヘグイ:アルビオンラグーンへの放流後の追跡調査の結果、移動経路、滞留および再捕が確認されたことなどにより、ヘグイのラグーン内放流は焼印標識を用いて移動分散経路が解明されつつある。</p> <p>③ウシエビ:無標識粗放養殖試験の追跡調査の結果、124 日後まで再捕され成長が確認された。また、尾肢切除による標識した種苗を放流した結果、98 年 3 月の調査までに合計 39 尾の再捕があり成長が確認された。</p> <p><b>1-2-2 ヘグイ、ウシエビの養殖研究の実施</b></p> <p>①ヘグイ:パラショア内で網生簀及びペン養殖に関する試験を実施し、餌料(ドライペレット)の開発・改良を行った。</p> <p>②ウシエビ:パラショア内で網生簀及びペン養殖に関する試験を実施し、種苗を民間専門業者へ供給した。</p> <p><b>1-3 ウシエビ及びアミメノキリガサミの親養成研究の実施</b></p> <p>①ウシエビ:親エビ産卵のための餌料系列が開発され、親エビ催熟試験マニュアルが作成された。</p> <p>②アミメノキリガサミ: 親ガニを仲買業者等から確実に入手でき、全ての雌ガニが飼育水槽内で産卵を行った。</p> <p><b>1-2,3,4 マニュアルの作成</b></p> <p>①ワムシ培養マニュアル (大量培養・保存培養完成)</p> <p>②ウシエビ種苗生産マニュアル (改良後下書き完成)</p> <p>③ウシエビ眼柄切除・人工精管移植マニュアル (完成)</p> <p>④ヘグイ種苗生産マニュアル (改良予定あり)</p> <p>⑤親ガニ養成マニュアル (現在下書き完成)</p> <p>⑥Aquaculture development in Mauritius(仮題) (総合マニュアル作成中)</p>	<p>・<b>阻害要因</b> 種苗生産量が小さいため、生産量に見合った配合飼料の入手が困難。一括して複数年分の大量の配合飼料を購入すると、配合飼料の品質劣化のために、後年の種苗生産に影響が見られた。</p> <p>・<b>阻害要因</b> モーリシャス国側の予算執行の遅れによりアルテミア耐久卵の入手が遅れ、種苗生産に支障を来した。</p> <p>・<b>阻害要因</b> C/P の勤務時間外の調査ができなかつたり、留学・異動により活動に若干の支障があった。</p> <p>・<b>阻害要因</b> パラショアでの養殖試験は、所内での養殖試験とは異なり管理が難しい。</p>

## 2. 沿岸環境調査

### 2-1 沿岸環境の様相を理解するためのペー・スライントークの収集

10 定期調査域において、水温、pH、塩分、溶存酸素(DO)、化学的酸素消費量(COD)、栄養塩(硝酸態窒素、リン酸態リン)の調査を行った。重金属に関しては全水銀、カドミウム、銅、鉛、亜鉛は港湾内及び河口域で採水した 18 試料の測定、残留農薬分析に関しては魚介類 9 試料中の有機塩素農薬及び PCB 残留濃度の測定、また港湾内及び河口域で採水した 11 試料中のアトランジン及びジウロンの残留濃度の測定を実施した。

### 2-2 ハルショアの物理化学的データの収集

養殖及び生態部門と共同で、定期調査域として Humbert ハルショア(3 回)、Montagu ハルショア(6 回)、Beau Rivage ハルショア(7 回)を調査し、一般調査として 13 のハルショアで調査を行った。各ハルショア調査では、4~6 カ所の調査点を設定して採水及び採泥を行い、水温、塩分、pH、DO、COD、栄養塩、底質の強熱減量を測定した。また、Beau Rivage ハルショアでは 99 年 10 月 25 日の大潮時に、干潮から満潮への中間時、満潮時、満潮から干潮への中間時、干潮時と 4 回のサンプリング調査を実施し、一日の変化を調査した。

### 2-3 C/P の化学分析及びデータ処理技術能力の向上

C/P のデータ処理に関し、パーソナルコンピュータの操作に慣れ当初に比べると大幅に処理能力が向上した。また、マクロプログラムを作成によって計算及び計算結果の報告書フォームへの変換及び調査域別保存が自動的に出来るようになり、計算ミスや報告書作成時の入力ミスがなくなった。また、異常値のチェックやデータの検索も容易になった。年報の作成や論文の作成を通してデータ解析能力が向上した。

### 2-4 沿岸水質ガイドラインの助言

モリシャス類似諸国の水質基準に関する資料、物理化学的パラメータの一般的特性及び毒性等の資料収集を行い、環境省を中心とした委員会に参加(約 2 年半)して原案作成にかかる必要な助言等を行った。

### 2-5 沿岸環境モニタリングマニュアルの作成

フィールド調査、分析室での基本操作、分析操作、分析チャートの各項に関し、図・写真・チャートを多用してドラフト原稿をほぼ完成した。

### ・阻害要因

重金属、残留農薬分析では、特殊な機材、試薬を使用するたため、業者の不慣れから納入が遅れた。

### 3. 沿岸生態調査

#### 3-1 海草及びマンゴローフ地域など沿岸生物相の研究

沿岸生物相の把握のためのデータ増補を行い、沿岸域生息生物のデータベース作成に必要な資料を整理・蓄積した。

#### 3-2 沿岸生態系のモニタリングシステムの構築

沿岸 8 地域の 17 サイトでラインインターセプトトランセクト(LIT)による底質状況のモニタリングを行った。サンゴ白化の原因となる水温変化を自記式水温計を用いて(途中、故障により中断はあったが)モニタリングした。また、サンゴ幼生の着定量・歩留り・成長量のモニタリングも継続中である。海草場に関し 2 カ所でマコ生息量の重点調査等を実施し、6 ヶ月毎にモニタリングを実施する予定である。

#### 3-3 ハラショアでの生態調査の実施

6 ハラショアで潜水調査を実施し、1998 年 8 月から 1999 年 12 月にかけては肉食性魚類(カマス類 45 個体、ヒラジ類 77 個体、フエダイ 17 個体)の胃内容物調査をおこなった。また、1999 年 4 月からアルビオンハラショアのプランクトンを 2 週間毎にモニタリングした。

#### 3-4 C/P 自身による沿岸生態調査能力の向上

各 C/P はサンゴ白化状況モニタリング、海草域分布調査、マコ分布調査、アルビオンリーフ内の生態系調査、ハラショア内肉食性魚類胃内容物調査に関し論文及び報告書を作成した。また、生態調査に必要な基本的な生物統計学も習得している。これまでの活動(生物分布調査、生態系影響評価等)で得られたデータ、標本、水中写真、観察記録等を整理しデータベースソフトウェアへ情報入力をする事によって各 C/P はデータベース構築の重要性を理解するようになった。

#### 3-5 科学文献による現今の沿岸生態系の研究

関連地域との情報交換網の形成、文献並びに書籍等の収集・調査によって沿岸生態系の現況を把握し、関連する知識及び技術の深化を図っている。

#### 3-6 技術報告書及び科学出版物の作成

調査結果は各月のスタッフミーティングおよび AFRC で毎年作成している Annual Report で報告されている。また、IOC(Indian Ocean Committee)に所属する各国と共同で報告書が作成されている。また、魚類図鑑はプロジェクト期間中に完成する予定である。さらに、広報資料(ポスター、パンフレット)を作成してモリシアス国民への啓蒙普及効果も行った。

#### ・阻害要因

深深度域のモニタリング調査は、1999 年度供与機材(データロギングコンピュータ)の到着が遅れた。

#### ・阻害要因

移動車両確保、移動時間等の問題から東海岸海草域での詳細調査が難しい。

#### ・阻害要因

沿岸域工事に伴う単発的な生態系調査のニーズの急増により計画的な調査が行いにくい状況になった。

#### ・阻害要因

生態調査班内での個別の研究について統括する海洋科学部長の理解が得られない。

#### ・阻害要因

コンピュータ台数が少ないため、データベース入力、報告書等の文書作成、データ解析等が効率的に行えない。

## 2. 案件の効果

<p>(1) 直接的効果 〔「プロジェクト目標」レベル〕</p>	<ul style="list-style-type: none"><li>・民間でのウジビ<sup>®</sup> 養殖の試みが始まった。</li><li>・モーリシャス国で初めて本格的な海面養殖であるヘガイの海上生簀養殖計画が開始された。</li></ul>
<p>(2) 間接的効果 〔「上位目標」レベル〕</p>	<ul style="list-style-type: none"><li>・セシェル国においても本プロジェクトが作成した沿岸水質ガイドラインを参考にして沿岸水質ガイドラインの策定を行っている。</li><li>・ポスターの製作と配布、及びセミナー講演などによりモーリシャス国民に対し、沿岸生態系・沿岸環境保護の重要性の啓蒙を頒布することができた。</li><li>・AFRC で生産されたヘガイの種苗を用いて、隣国のレユニオン国でもヘガイ養殖試験が開始されることにより、周辺国への貢献と共に同セクターにおけるモーリシャス国の対外的地位の向上にも寄与している。</li></ul>

### 3. 実施効率性

<p>(1)投入のタイミングの妥当性</p> <p>(日本側)</p> <ul style="list-style-type: none"> <li>・ 専門家の派遣</li> <li>・ 機材の供与</li> <li>・ 研修員の受入れ</li> </ul> <p>(相手側)</p> <ul style="list-style-type: none"> <li>・ 土地、施設、機材の措置</li> <li>・ C/P の配置</li> <li>・ ローカルコストの負担</li> <li>・ その他</li> </ul>	<p>(日本側)</p> <ul style="list-style-type: none"> <li>・ 一部機材について、現地調達ルートの開拓に時間を要したことにより供与が遅れ、活動の進捗に影響を与えた。(現地調達ルートの開拓は、プロジェクトの持続性維持の点から不可欠であると考えられる。また、ルート開拓後は、計画通り調達できている)。</li> <li>・ その他の投入については、ほぼ計画通り行われた。</li> </ul> <p>(相手側)</p> <ul style="list-style-type: none"> <li>・ 機材の購送に係る税関手続き、免税措置及び水産・組合省側の予算執行に時間を要し活動の進捗に若干の影響を与えた。</li> <li>・ その他の投入については、ほぼ計画通り行われた。</li> </ul>
<p>(2)投入と成果の関係 (投入の量・質と成果の妥当性)</p> <ul style="list-style-type: none"> <li>・ 専門家の派遣</li> <li>・ 機材の供与</li> <li>・ 研修員の受入れ</li> <li>・ 土地、施設、機材の措置</li> <li>・ C/P の配置</li> <li>・ ローカルコストの負担</li> </ul>	<ul style="list-style-type: none"> <li>・ C/P の異動は 1 名のみであり、C/P の定着率は非常に高いが、アシスタントは臨時職であることもあり異動がたびたび行われた。このことにより継続的な活動に対し一部支障があった。</li> <li>・ その他に関しては、特に問題はなく、所期の効果があったと考えられる。</li> </ul>
<p>(3)無償等他の協力形態との リンケージ/JBIC、第 3 国国際援助機関による協 力とのリンケージ</p>	<ul style="list-style-type: none"> <li>・ AFRC は、過去 2 回の無償資金協力により建設、拡充されており、本プロジェクトでは、これらの施設及び機材を有効に活用した。</li> </ul>
<p>(4) その他</p>	<ul style="list-style-type: none"> <li>・ プロジェクト後半において、AFRC の調査研究能力の向上にともない、AFRC の本来業務である環境・生態調査の調査頻度と作業量が増加し C/P の業務量が増加した。その結果、専門家から C/P への技術移転時間が不足し、プロジェクト全体の進捗に若干の影響を与えた。</li> </ul>

#### 4. 当初計画の妥当性

1. 上位目標の妥当性	・ モーリシアス国の水産開発政策は、「環境保全・資源保全を図りながら水産振興をはかる」ことであり本プロジェクトの上位目標は、現在でも妥当である。
2. プロジェクト目標の妥当性	・ 水産物は、モーリシアス国民の重要なタンパク源であり、かつ、著しい観光産業の発展により沿岸魚介類の急激な需要の増加がみられる。また、沿岸環境保全は沿岸漁場環境の保全と同時に沿岸観光産業の発展維持のために重要である。そのためにもモーリシアス国の水産分野における唯一の研究開発機関である AFRC の機能向上は不可欠であり、本プロジェクト目標は妥当である。
3. 計画設定の妥当性 (目標設定、プロジェクト目標、成果および投入の相互関連性、実施スケジュール等)	・ モーリシアス国民の栄養源、並びに主要な国家収入の一つである観光業ためにも沿岸資源の開発と保全は重要であり、AFRC の総合的機能の強化は必要事項である。そのために、わが国が資源増殖分野、沿岸環境調査分野及び沿岸生態調査分野への各協力活動は必要不可欠であり、妥当である。

## 5. 自立発展の見通し

	中間評価時の見通し	終了時評価の見通し
<p>1. 制度的側面 (政策的支援、スタッフの配置・定着状況、類似組織との連携、運営管理能力等の観点から記述)</p>	<ul style="list-style-type: none"> <li>・ C/P は技術的能力的に問題はないが、会議の出席や環境影響評価による業務過多、また作業員の突然の人事異動等の問題点は見られる。</li> </ul>	<ul style="list-style-type: none"> <li>・ AFRC は、モーリタス国における海洋環境調査の責任機関であり、海洋環境調査の重要性が増している現状において、政策的支援について問題はない。</li> <li>・ C/P の定着率は高いが、アシスタントは臨時職であり異動がたびたび行われている。各種調査においては、アシスタントの知識・技術の向上も不可欠であることから継続雇用が望まれる。</li> </ul>
<p>2. 財政的側面 (必要経費の資金源、公的補助の有無、自主財源、経理処理状況等の観点から記述)</p>	<ul style="list-style-type: none"> <li>・ AFRC の予算については毎年一定の必要経費が配置されているので今後も継続するものと思われる。</li> </ul>	<ul style="list-style-type: none"> <li>・ 必要最低限な財源は確保されているが、予算執行に時間を要している。迅速な経理処理ができる体制を構築する事が望まれる。</li> <li>・ 経費削減のため、勤務時間外の超過勤務が禁止されており、調査業務に支障をきたしたこともあるので調査研究のための財源確保、及びフレキシブルな勤務体制が望まれる。</li> </ul>
<p>3. 技術的側面 (移転された技術の定着状況、施設・機材の保守管理状況、現地の技術的ニーズとの合致状況等の観点から記述)</p>		<ul style="list-style-type: none"> <li>・ ほとんどの調査研究項目（フォローアップ想定項目を除く）について、独自で活動を実施できる水準に達しており問題はない。</li> <li>・ 一般的な機材の保守管理は比較的良好であるが、原子吸光光度計や液体クロマトグラフ等の特殊な分析機器の保守管理に関し外注できる適当な代理店が国内にはないので保守管理に問題が残る。</li> <li>・ 現在の AFRC の機材保守管理体制では対応が不十分なので、モーリタス政府の予算執行等制度面の見直しも必要である。</li> </ul>
<p>4. その他</p>		



IV. プロジェクトの展望、教訓および提言

<p>1. 延長もしくはフォローアップの必要性 (必要な分野/方法/実施のタイミング/理由)</p>	<p>評価結果を踏まえ、協力期間を延長することが必要か否か、もしくはフォローアップの必要性があるかどうかを示し、そのような結論にいたった判断理由を要約して記入)</p> <p>「資源増殖」及び「生態調査」の2分野についてフォローアップが必要であると考えられる。なお、協力期間は2年間で適当であると考えられる。</p> <p><b>1. 資源増殖分野</b> プロジェクト期間中にはヘダイ及びアミメノコギリガザミの種苗生産に関する基礎的な技術移転がなされ、カウンターパートは作業工程を理解した。その結果、ある程度の種苗を生産することができるようになった。 しかしながら、当初想定されていなかった奇形魚、病気の発生等により、ヘダイ及びノコギリガザミの健全で安定的な種苗生産を行うまでにはいたっておらず、今後、より細かな飼育環境の制御等、独自の技術開発能力の向上が要求される。このため、さらなる協力（フォローアップ）を行うことが必要であると考えられる。</p> <p>また、プロジェクト期間中ヘダイの放流が行われ、種苗放流に関する基礎的な技術移転がなされた。焼印標識を用いた放流後の追跡調査が行われ、放流後の行動生態が解明されつつある。しかしながら、放流効果はプロジェクト期間内では確認できるほど短期的なものではないため、本国独自で長期間に渡って放流を続けて行けるような体制を構築する必要があると考えられる。 放流事業は周辺国では行われていないため、当技術の確立はインド洋西部地域の資源増殖技術の発展にも寄与するものと考えられる。フォローアップが必要であると考えられる活動は次のとおり。</p> <p>アルビオン水産研究所養殖部門では、すでに周辺島嶼国に対して生産した種苗を供給している。将来的にはこれらの国との連携を含めて、インド洋西部の熱帯・亜熱帯域における種苗生産を柱とした資源増殖分野研究の中心をなし得るところである。</p> <p>①アミメノコギリガザミ種苗生産 種苗の安定供給は未だ達せられていないが、これまでに真菌症対策、植物プランクトンの添加効果、適正塩分濃度等基礎的な技術移転がなされた。さらに細かな生物的・物理的飼育環境の制御技術の開発が行われれば、目標生産尾数に達せられると思われる。モーリシャスにはバラショアという特殊な増養殖環境があるので、本種の種苗供給は期待されている。</p> <p>②ヘダイ種苗生産 本種に関しては10万尾レベルでの安定的な種苗生産は達せられたが、養殖用種苗のため形態異常魚を防ぐ必要がある。高品質な種苗を供給するためには、更なる技術改良が必要である。そのため</p>
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には、現状の勤務体制にとられない調査体制が望まれる。

### ③ヘダイ種苗放流

生産された種苗を用いて、ヘダイの標識放流が行われた。追跡調査が行われ、放流魚の移動・滞留場所が特定された。しかしながら、成長や再生産の可能性等データ解析は行われなかった。今後資源増殖の科学的な評価を行うために、データ収集及び解析技術の確立は必要不可欠と思われる。

## 2. 生態調査分野

本プロジェクトにおいて、様々な活動が行われてきた。しかしながら、取り扱う生物種類数の多さから世界的にも重要なサンゴ礁保全に係る調査が緒についたばかりであり、さらなる協力（フォローアップ）を行うことが必要であると考えられる。

1998年の夏に起こった大規模なサンゴの白化により世界各地の造礁サンゴは壊滅的な状況にある。1970年代におこったオニヒトデによる食害から回復する過程で20余年を要したことを考えると、各海域でのサンゴ礁の回復にはさらに多くの年月を要するものと推察される。サンゴ礁における造礁サンゴの死滅は、造礁サンゴを餌とし、また生息場所としている海洋生物の群集組成を大きく変化させた。またそれまで造礁サンゴであった有機物が分解される過程で、含まれていた栄養塩を水中に放出し、プランクトンや微細藻類の繁茂させる要因となり、サンゴ礁生態系の構造を大きく変化させつつある。これらの連鎖的変化はやがては沿岸の漁業や観光産業に大きな影響を与えるのではないかと憂慮される。

2000年2月に東京で開催された国際サンゴ礁シンポジウムにおいて、オーストラリアや米国を中心とした複数の研究者は、これまでの表層海水温の上昇傾向から、2030年までに複数回の世界規模の白化現象が起り、その結果世界のサンゴ礁の大部分が壊滅する可能性を示唆している。

サンゴ礁島嶼国であるモーリシャスにおいては、島をとりまくサンゴ礁はこの国の水産業の基盤となっているだけでなく、この国を支えている観光業にとっても重要な要素となっている。そのような状況下で、上述したサンゴ礁の危機的状況を考えると、この国における造礁サンゴのデータベースの完成と、造礁サンゴの個体群過程・群集動態を把握するためのモニタリング法についての技術移転が急がれる。アルビオン水産研究所はインドー太平洋サンゴ礁域の西端に位置し、サンゴ礁の世界的動態を把握する上で、重要な位置に置かれている。この研究機関の成果は、一義的にはモーリシャス沿岸のサンゴ礁生態系の保全を目的としたものであるが、同時に生活基盤であるサンゴ礁生態系の破壊にさらされている、インドー太平洋の他の島嶼国のサンゴ礁保全・回復にも寄与するものと考えられる。

フォローアップが必要であると考えられる活動は次のとおり。

### ①個体群生態学的研究

サンゴ礁域に新規加入したサンゴの量、成長率などを把握する個体群生態学的調査は、サンゴ礁の保全管理を行う上で重要である。これまで、アルビオン礁池内に稚サンゴ着定板を設置し、定期観測を行っ

	<p>てきたが、今後、観測地点や設置着定板数を増加させ、さらに複数年の調査を継続することで、サンゴ礁管理を行う上で重要と考えられる。</p> <p>②サンゴデータベースの充実およびモーリシャスサンゴ図鑑  これまで沿岸生息魚類およびサンゴのデータを記録するためのデータベースシステム構築し、沿岸生息魚については 300 種以上について登録が終了し、現在、沿岸魚類図鑑を作成中である。サンゴについても既に 50 種以上が記録されているが、モーリシャス沿岸のサンゴ相を把握するためにはさらに標本の収集・記録が必要と考えられる。サンゴデータベースの充実に伴って C/P や他のスタッフのサンゴ同定技術も向上することが期待される。また、サンゴデータベース充実の結果として、モーリシャスサンゴ図鑑を作成・配布することにより、AFRC 内のスタッフの参考資料だけでなく、一般への啓蒙普及効果も期待される。</p> <p>③報告書の作成  これまで合計 28 報の報告書を作成したが、未発表のデータも残されており、これらのデータの重要性を考えると、さらに報告書および科学出版物の作成が必要である。</p>
<p>2. 教訓と提言 ①教訓</p>	<p>プロジェクト後半において、AFRC の調査研究能力の向上にともない、AFRC の本来業務である環境・生態調査の調査頻度と作業量が増加し C/P の業務量が増加した。その結果、専門家から C/P への技術移転時間が不足し、プロジェクト全体の進捗に若干の影響を与えた。</p> <p>このことから、相手国実施機関の能力向上にともなう、プロジェクト期間中にかかる相手国実施機関の本来業務の増加を見込んだ計画立案が望まれる。</p>
<p>②短期的提言</p>	<p>沿岸環境調査分野については、本来のプロジェクト期間内で終了が可能であり、以下の活動を残りの協力期間内で完結させるべく努力することが望まれる。</p> <p>ア 海生動物と低質標本の重金属分析  ベースライン（基準）データを集めるために同分析は必要である。</p> <p>イ マニュアル作成  沿岸環境調査及び増養殖調査に関するマニュアル作成を完了すべきである。</p>

<p>③長期的提言 (制度的改革等が必要なもの)</p>	<p>ア 調査研究活動の成果を広く示すためにもテクニカル・レポートや学術論文の定期的な発行・投稿が望まれる。</p> <p>イ 水産研究に貢献し、モーリシャスの沿岸環境の保全に貢献するためにも、アルビオン水産研究所の予算を維持することがモーリシャス側に望まれる。</p> <p>ウ 日本供与のみならず全ての資機材を良い状態に維持管理すべきである。</p> <p>エ 移転された技術を長期にわたって維持活用するためにも、継続したオフィサー及びアシスタントの配置が望まれる。</p> <p>オ 沿岸環境調査においては、調査頻度と作業量が環境問題の発生に伴って大きく増大してきており、この活動分野の業務量に比例してより多くの人員が適切に配置されるべきである。</p> <p>カ 現在の所定就労時間（午前9時から午後4時まで）はいくつかのプロジェクト活動にとっては不適であり、臨機応変にこの就労時間外にも業務が認められるよう検討されるべきである。</p>
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## 7 合同評価会議議事録



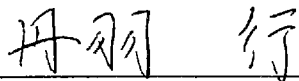
**THE MINUTES OF MEETING  
BETWEEN  
THE JAPANESE EVALUATION TEAM  
AND  
THE AUTHORITIES CONCERNED  
OF THE GOVERNMENT OF THE REPUBLIC OF MAURITIUS  
ON  
JAPANESE TECHNICAL COOPERATION  
FOR  
THE COASTAL FISHERIES RESOURCES AND ENVIRONMENT  
CONSERVATION PROJECT**

The Japanese Evaluation Team (hereinafter referred to as "the Team"), organized by the Japan International Cooperation Agency (hereinafter referred to as "JICA") and headed by Mr. Akira Niwa visited the Republic of Mauritius from June 25th to July 9th, 2000.

During the Team's stay in the Republic of Mauritius, the Team had a series of discussions with the Mauritian authorities concerned, and jointly evaluated the present achievement of the Coastal Fisheries Resources and Environment Conservation Project (hereinafter referred to as "the Project").

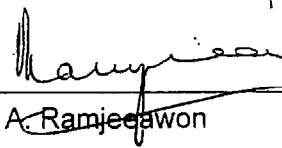
As a result of the discussion, both sides agreed to report to their respective Governments the matters referred to in the documents attached hereto.

Port Louis, July 7th, 2000



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Mr. Akira Niwa  
Leader  
Japanese Evaluation Team  
Japan International Cooperation  
Agency  
Japan



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Mr. A. Ramjeeawon  
Acting Permanent Secretary  
Ministry of Fisheries and  
Co-operatives  
Republic of Mauritius



## THE ATTACHED DOCUMENT

### I. INTRODUCTION

#### 1. Background of the Project

In its 6<sup>th</sup> National Development Plan (1992 to 1994), Mauritius regarded research as indispensable for making the best use of ocean resources on a sustainable basis. The Albion Fisheries Research Center (hereinafter referred to as "AFRC") is the only institution in Mauritius to conduct studies on fishery and marine resources. This Project was requested with the objective of enhancing the capability of the center with regard to conservation of coastal resources and environment.

Under these circumstances the Coastal Resources and Environment Conservation Project started in December, 1995 with a project period of 5 years. With the remaining project period of approximately 6 months, the Team visited Mauritius from June 25th, 2000 to evaluate the achievement of the Project together with Mauritius side.

#### 2. Objectives of Evaluation

Objectives of the evaluation are as follows:

- (1) To execute a comprehensive evaluation of the present achievement in accordance with the original plan documented in Record of Discussion (R/D), Tentative Schedule of Implementation (TSI), Annual Work Plan and Project Design Matrix (PDM).
- (2) To make recommendations and suggestions to the authorities of the respective Governments concerning the measures to be taken for the rest of the project period and after the termination of the project.

#### 3. Methodology of Evaluation

##### 3-1 Survey

The Project was evaluated jointly by the Japanese and Mauritian sides. The Team visited

the project site, and carried out a series of hearings from the Mauritian counterpart personnel and Japanese long-term experts.

### **3-2. Items of the Evaluation**

#### **3-2-1. Achievement of the Project**

Achievement of the Project was evaluated in terms of inputs, activities, outputs and project purpose, all of which are in accordance with Record of Discussion (R/D), Tentative Schedule of Implementation (TSI) and Project Design Matrix (PDM).

#### **3-2-2 Analysis on Evaluation Issues**

##### **(1) Effectiveness**

Effectiveness was assessed by evaluating the extent to which the Project has achieved outputs and project purpose.

##### **(2) Impact**

Impact of the Project activities was identified as positive and negative changes produced by the Project directly and indirectly (including unexpected changes).

##### **(3) Efficiency**

Efficiency of the Project implementation was analyzed focusing on the relationship between inputs and outputs in terms of timing, quantity, and on linkage with other cooperation schemes of JICA and other organizations.

##### **(4) Rationale**

Rationale of the Project was reviewed as the validity of project purpose and overall goal in connection with the development policy of the Government of Mauritius and needs of the beneficiaries.

##### **(5) Sustainability**

Sustainability of the Project was forecasted in organizational, financial and technical aspects by examining the extent to which the achievement of the Project is sustained or expanded after the assistance is completed.

#### 4. PDM for Evaluation

PDM was not prepared at the start of the Project. Therefore, through review of past documents and discussions with the parties concerned, the Team and the Mauritian side agreed to use the PDM summarized in Appendix 1.

A narrative summary of the PDM is as follows:

##### The Overall Goal of the Project:

To continuously utilize coastal fisheries resources and conserve the coastal environment in the Republic of Mauritius.

##### The Purpose of the Project:

To systematically strengthen the research capabilities of Albion Fisheries Research Center (hereinafter referred to as "AFRC") in the field of coastal fisheries resources propagation and research into the coastal ecosystem and environment.

##### Outputs:

###### **Resource Propagation**

1. Technique of mass seed production was improved.(Seed Production)
2. Suitable release and culture technique in barachois were studied and acquired.  
(Barachois Study)
3. Induced spawning techniques were acquired.(Brood Stock Rearing)

###### **Coastal Environment Research**

4. A coastal environment monitoring system was established.

###### **Coastal Ecosystem Research**

5. The methods of coastal ecosystem research and monitoring technique were improved.

##### Activities:

###### **1. Resources Propagation**

- 1-1. To carry out research and development for mangrove crab, sea bream and black tiger shrimp

- 1-2-1. To develop liberation technique of sea bream, black tiger shrimp and mangrove crab.
- 1-2-2. To conduct culture study on sea bream and black tiger shrimp.
- 1-3. To carry out research on induced spawning technique for black tiger shrimp and mangrove crab.
- 1-1,2,3. To produce technical manuals.

## **2. Coastal Environment Research**

- 2-1. To compile baseline data to understand the tendency of coastal environment.
- 2-2. To collect physicochemical data in barachois.
- 2-3. To enhance the capability of C/P in chemical analysis and data processing.
- 2-4. To formulate coastal water quality guidelines.
- 2-5. To produce manuals for coastal environmental monitoring.

## **3. Coastal Ecosystem Research**

- 3-1. To study the distribution of coastal resources, such as coral, sea grass and mangrove areas.
- 3-2. To design a monitoring system for the coastal ecosystem.
- 3-3. To conduct ecological survey in barachois.
- 3-4. To enhance self-study ability of C/P on coastal ecosystem research.
- 3-5. To study current coastal ecosystem through reviewing scientific literature.
- 3-6. To produce technical reports and publications.

## II. RESULTS OF EVALUATION

### 1. Achievement of the Plan

#### 1-1. Achievement of Inputs

Refer to Appendix 2 in details.

##### (1) Japanese side

- 1) Dispatch of Experts  
In accordance with the R/D, the Japanese side dispatched nine(9) long-term experts and fourteen(14) short-term experts to the Project.
- 2) Training of Mauritian Counterpart Personnel  
Twelve (12) Mauritian Counterpart Personnel were trained in Japan.
- 3) Provision of Machinery and Equipment  
The Machinery and Equipment of approximately 138 million yen were provided for the Project.
- 4) Local Expenditure  
Approximately 26 million yen was spent for the Project activities.

##### (2) Mauritian side

- 1) Provision of Land, Buildings and facilities  
The necessary spaces for office and laboratories of the Project have also been provided in line with the R/D.
- 2) Allocation of Local Cost  
A recurrent budget of approximately 2 million rupees (excluding expenses related to electricity, telephone, water charges, transportation and salary of staff amounting to Rs. 30 million rupees) per year was allocated for on going activities of the Project, including expense incurred on other projects implemented by AFRC.
- 3) Allocation of Counterpart Personnel  
Twelve (12) Counterpart Personnel from AFRC were allocated.

#### 1-2. Achievement of Activities

Refer to Appendix 5.

#### 1-3. Achievement of Outputs

Refer to Appendix 5.

#### 1-4. Achievement of Project Purpose

During four and half years, the Project made effort to strengthen research capabilities of AFRC by transferring knowledge and technology from Japanese side and study carried out by C/P themselves.

As the result of these activities, several advanced techniques and know-how were introduced and some important scientific papers were published. The activities of dispatched long-term and short-term experts and the supplied equipment have been highly appreciated by the Mauritian side and C/P who were trained in Japan have been working in AFRC. Though some figures of results on activities were under their targets, it is certain that technology and knowledge transferred from Japanese side were acquired by C/P.

Hence, the achievement of Project Purpose is evaluated to be on satisfactory level.

## 2. Analysis on the Five Evaluation Criteria

### 2-1. Effectiveness

The effectiveness of the Project is judged as high.

The most important factors in order to achieve the Project Purpose are to prepare the physical infrastructure in AFRC and to develop necessary human resources for conducting professional knowledge and skill in Resource Propagation, Coastal Environment Research and Coastal Ecosystem Research.

Necessary equipment was distributed by the Japanese side and the C/P can operate those equipment very well. C/Ps have been working and transferring their knowledge and skill to colleagues at works.

While the Project moved on, several significant scientific papers and articles were published, and C/Ps improved their capacities by themselves and through the advice of Japanese Experts.

However, since some necessary activities of the Project which were planned at beginning or middle of the Project still remain, it is necessary that they are continued.

### 2-2. Impact

Impact of the Project is positive. Negative Impact does not exist.

As direct Impacts; Trials of culture of shrimp and sea bream already began in private sector. Papers and scientific studies were published. The capabilities, which are composed of soft (knowledge, skill and management) and hard (necessary equipment)

of AFRC were improved.

As indirect Impacts; It is certain that the formulation of Coastal Water Quality Guidelines with the cooperation of the project contributed to the Environmental Conservation Policy in Mauritius. Distribution of Posters and organisation of seminars contributed to public awareness on the preservation of the ecosystem and environment. Cooperation of AFRC with neighbouring countries also contributed to improve its position as a research center in Mauritius.

### **2-3. Efficiency**

The efficiency of the Project is judged as high.

Long-term and short-term experts transferred technical knowledge and skills in 3 fields smoothly to C/Ps. Judging from the reports and documents and interviews with Japanese experts and C/P, the timing of Inputs of Japanese side was appropriate. Although the delivery of some equipment was delayed, the Project was carried out as scheduled.

The timing of Inputs of Mauritian side was appropriate. Twelve(12) C/P continued to work in AFRC. C/Ps who were trained in Japan had been able to transfer the knowledge and skill to staff of AFRC.

### **2-4. Rationale**

Overall Goal is valid because the development policy in the fishery field is "to promote the fishery industry in keeping with the preservation of the coastal environment and coastal ecosystem in healthy conditions". In order to develop tourism, fisheries resources are needed. A healthy coastal ecosystem and environment is important to public and tourists.

AFRC is the only fisheries research center in Mauritius which has the responsibility to carry out research on the coastal environment. The project purpose is appropriate as it aimed at improving the capacity of AFRC in order to contribute to the overall goal.

Activities were carried out by suitable inputs in Resource Propagation, Coastal Environment Research and Coastal Ecosystem Research. As these activities are necessary to achieve the Project Purpose and Overall Goal, the relationship between them is appropriate.

### **2-5. Sustainability**

#### **(1) Organizational Aspect**

As only AFRC has the responsibility to carry out research in the coastal environment and the public places great importance on the healthy environment around Mauritius,

the government of Mauritius gives its full support to the project. It is hoped that the Authority continues to employ officers and assistants because of the knowledge and skill they have acquired for the activities of AFRC.

As the activities of AFRC focus on natural resources, research on these aspects is a long term process. Any investigation related to natural resources cannot be limited to fixed time.

**(2) Financial Aspect**

Even though provisions in the budget were made, some problems in their allocation delayed the implementation of the project a little. It is hoped that adequate and timely budgetary input will contribute to the execution of the project on schedule.

**(3) Technical Aspect**

AFRC can maintain general equipment and keep them under good condition. But some special equipment is difficult to maintain in Mauritius because of lack of agents. It is desirable that adequate budget for periodical maintenance and emergency repair of special equipment be secured.





### **III. RECOMMENDATION**

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#### **1. Short-term recommendation**

In order to make the project achievement more successful, following activities should be completed in the remaining period.

- (1) Heavy metal analysis for marine fauna and sediment samples

The analysis should be carried out to collect baseline data.

- (2) Manuals

Manuals of coastal environment and resources propagation should be finalized.

#### **2. Long-term recommendation**

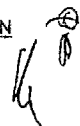
- (1) It is desirable that the technical report and scientific papers be published regularly in order to present the results of research activities.
- (2) To contribute to the fisheries research and conservation of the marine environment in Mauritius, it is desirable for the Mauritian side to make effort for maintaining the budget for AFRC.
- (3) The machinery and equipment including those provided by Japan should be maintained in a good condition.
- (4) To maintain the transferred techniques for long, continuous assignment of officers and assistants is desirable.
- (5) In the coastal environment monitoring sampling frequency and workload have drastically increased with environmental problems. The volume of work for this component is increasing and more staff should be allocated to continue the work properly.
- (6) Since the current working hours(9:00-16:00) is not suitable for some activities, flexible working hours should be considered.

#### **3. Follow-up activity**

##### **3-1. The necessity for follow-up**

##### **3-1-1. Resources Propagation**

Counterparts have acquired seed production techniques of sea bream and mangrove crab. Therefore, the AFRC could produce fingerlings and juveniles. However, this



technique must be improved by counterparts themselves to control larval rearing condition in order to increase production. If these techniques could be improved and refined, same could be made available to the private sector.

Release experiments were carried out during JICA project period. The basic techniques have been transferred to counterparts. The movement pattern of released sea bream (with branding marks) was being followed. However, for such release activity to be efficient, it should be carried out on a long term basis. A long term investigation would be necessary with a good system of monitoring, data collection and analysis. Release techniques of sea bream have not yet been developed by countries of this region. If the stock enhancement is successful in Mauritius, then the technology of release should be developed further. Mauritius could contribute to the expansion of these techniques in the region

AFRC distributed fingerlings produced to neighbouring countries. In the future, it is expected that AFRC could become a leader in seed production propagation in tropical and sub-tropical region in the western part of the Indian Ocean.

### **3-1-2. Coastal Ecosystem Research**

From 1995 to date, substantial work has been completed. However, there is need for the collected data to be analysed and interpreted. Furthermore, there is a need to conduct indepth studies in population process of scleractinian corals alongside the monitoring programme already established.

Coral reefs in the world are facing world-wide destruction following the 1998 mass bleaching event. Considering the time span of 20 years taken for coral reefs to recover from Acanthaster (crown-of-thorns) attack, it is estimated that much more time will be needed for corals to recover from the bleaching phenomenon. The disappearance of reef building corals has caused apparent changes in the community structure of coral reef associated organisms. Moreover, the mass mortality of corals has caused the release of nutrients, causing enrichment of the water body which has in turn led to a proliferation of phytoplankton and seaweed. Such drastic change in the marine ecosystem may hence affect coastal fisheries and alter the intrinsic value of coral reef areas.

During the International meeting on coral reefs held in Tokyo in February 2000, scientists from the USA and Australia predicted that the gradual increase in sea water temperature will continue until 2030, based on the data obtained over the past years. Consequently, they predicted the occurrence of future severe bleaching episodes.

In Mauritius, coral reefs surrounding the island do not only support fisheries but are

of great economic value to the country. Since Mauritius is located in the region where coral reefs are susceptible to bleaching, it is important to complete the database of scleractinian corals and continue the monitoring programme, coupled with studies on coral population dynamics.

AFRC is located at the West border of the Indo-Pacific Reef Province and has an important role to play in the study of marine ecosystems. The findings of the centre are not only of importance to the local community but will contribute towards the conservation and management of coral reefs in the Indo-Pacific region.

### **3-2. The contents of the follow-up**

#### **3-2-1. Resources Propagation**

##### **(1) Mangrove crab seed production**

The target number of seed production of mangrove crab has not yet been achieved. However some basic techniques such as control of fungal disease, the effect of phytoplankton in larval rearing water, salinity, etc. have been transferred to counterparts. To be successful in reaching target set, the physical and biological parameters of the rearing tanks should be carefully monitored.

Barachois have specific conditions for the development of crab aquaculture. It is expected that the owners of barachois would make the best use of crab seed supply.

##### **(2) Sea bream seed production**

Mass production of this species was achieved by the production of some 100,000 fry. However, many deformed fish could be found, which could not be used for culture purposes.

To supply good quality fingerlings to fish farmers, AFRC must improve the technique of sea bream seed production. This could be achieved by proper monitoring of larval rearing and live feed tanks from early morning to late evening.

##### **(3) Sea bream release experiment**

Some sea bream produced were released in the lagoon and their movement pattern was followed. The data on growth and reproduction were not investigated. To evaluate stock enhancement it is necessary to develop techniques of data collection and analysis.

#### **3-2-2. Coastal Ecosystem Research**

##### **(1) Database and field guide of corals**



## List of Appendix

1. Project Design Matrix (PDM)
2. Chart of input
3. Chart of counterpart allocation
4. List of provided machinery and equipment
5. Evaluation of each component

11  
A  
11

**PDM (Project Design Matrix) of  
The Coastal Fisheries Resources and Environment Conservation Project in the Republic of Mauritius**

(Duration: 1<sup>st</sup> December, 1995 - 30<sup>th</sup> November, 2000)

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption
<p><b>Overall Goal</b></p> <p>To continuously utilize coastal fisheries resources and conserve the coastal environment in the Republic of Mauritius.</p>	<ul style="list-style-type: none"> <li>• Data on catches by species</li> <li>• Data on tourists</li> </ul>	<ul style="list-style-type: none"> <li>• Fisheries Statistics</li> <li>• Tourism Statistics</li> </ul>	<ul style="list-style-type: none"> <li>• Environmental State and Development Policy of Mauritius do not change.</li> </ul>
<p><b>Project Purpose</b></p> <p>To systematically strengthen the research capabilities of Albion Fisheries Research Center in the field of coastal fisheries resources propagation and research into the coastal ecosystem and environment.</p>	<ul style="list-style-type: none"> <li>• Number of trained staffs</li> <li>• Number of equipment</li> <li>• Number of publications</li> </ul>	<ul style="list-style-type: none"> <li>• Record of activities of AFRC</li> <li>• References related to coastal fisheries and environment</li> </ul>	<ul style="list-style-type: none"> <li>• Public and Tourists in Mauritius cooperate to keep natural resources in healthy condition.</li> <li>• Public accepts and supports AFRC activities.</li> </ul>
<p><b>Outputs</b></p> <p><b>1 Resource Propagation</b></p> <p>1-1 Technique of mass seed production was improved. (Seed Production)</p> <p>1-2 Suitable release and culture technique in barachois were studied and acquired (Barachois Study)</p> <p>1-3 Induced spawning techniques were acquired. (Brood Stock Rearing)</p>	<p>1-1 Achievement to the target number; 10,000 crab (C1), 200,000 sea bream (20mm size), 100,000 shrimp (PL30; 1996-97)</p> <p>1-2-1 Release in barachois and lagoon; 10,000 crab (C1;1998-2000), 100,000 shrimp (1g;1996-2000), 100,000 sea bream(30mm,size;1997-2000)</p> <p>1-2-2 Culture in barachois; 100,000 sea bream (30mm size), 100,000 shrimp(1g) from 1996 to 2000</p> <p>1-3 Collect shrimp adult(150) and mangrove crab(50) spawners</p>	<ul style="list-style-type: none"> <li>• Monthly, quarterly and Annual reports</li> <li>• Reports &amp; Publications</li> <li>• AMAS reports</li> </ul>	<ul style="list-style-type: none"> <li>• Qualified and sufficient staffs are allocated for AFRC.</li> <li>• Sufficient budgets are allocated for AFRC.</li> </ul>
<p><b>Outputs</b></p> <p><b>2 Coastal Environment Research</b></p> <p>2 A coastal environment monitoring system was established.</p>	<p>2-1 Records of monitoring at regular sites</p> <p>2-2 Number of Barachois surveyed</p> <p>2-3 Guidelines formulated for coastal water quality</p> <p>2-4 Manuals for coastal environment monitoring produced</p> <p>2-5 Analysis technique acquired</p>	<ul style="list-style-type: none"> <li>• Monthly, quarterly and Annual reports</li> <li>• EIA reports</li> <li>• Manual published</li> <li>• Guideline in Government Gazette</li> <li>• AMAS reports</li> </ul>	<ul style="list-style-type: none"> <li>• Qualified and sufficient staff are allocated for AFRC.</li> <li>• Sufficient budgets are allocated for AFRC.</li> </ul>

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<p><b>Outputs</b>  <b>3 Coastal Ecosystem Research</b></p> <p>3 The methods of coastal ecosystem research and monitoring technique were improved.</p>	<p>3-1 Database constituted on marine organism          3-2 Monitoring of 8 locations biannually          3-3 Number of barachois researched          3-4 Number of reports and scientific publications under the framework of the project</p>	<ul style="list-style-type: none"> <li>• Monthly, quarterly and Annual reports</li> <li>• Reports &amp; Scientific Publications</li> <li>• AMAS reports</li> </ul>	<ul style="list-style-type: none"> <li>• Qualified and sufficient staffs are allocated for AFRC.</li> <li>• Sufficient budgets are allocated for AFRC.</li> </ul>																							
<p><b>Activities</b>  <b>1 Resources Propagation</b></p> <p>1-1 To carry out research and development for mangrove crab, sea bream and black tiger shrimp          1-2-1 To develop liberation technique of sea bream, black tiger shrimp and mangrove crab          1-2-2 To conduct culture study on sea bream and black tiger shrimp          1-3 To carry out research on induced spawning technique for black tiger shrimp and mangrove crab          1-1,2,3 To produce technical manuals</p>	<p><b>Mauritian Inputs</b></p> <p><b>1 Counterpart Personnel</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding-left: 20px;">Resources Propagation</td> <td style="text-align: right;">4</td> </tr> <tr> <td style="padding-left: 20px;">Coastal Ecosystem Research</td> <td style="text-align: right;">4</td> </tr> <tr> <td style="padding-left: 20px;">Coastal Environmental Research</td> <td style="text-align: right;">4</td> </tr> </table> <p><b>2 Land, Building, facilities</b></p> <p><b>3 Expense(Unit: 1,000Rps)</b> 10,200 recurrent budget only * (FY1995-FY2000)</p> <p>*: Including expense incurred on other projects implemented by AFRC. Expenses related to electricity, telephone, water charges, transportation and salary of staff are not included.</p>		Resources Propagation	4	Coastal Ecosystem Research	4	Coastal Environmental Research	4	<ul style="list-style-type: none"> <li>• Technically trained C/P will continue their service at AFRC.</li> <li>• Workload of C/P will not increase.</li> <li>• Maintenance of equipment and accessories are timely conducted.</li> </ul>																	
Resources Propagation	4																									
Coastal Ecosystem Research	4																									
Coastal Environmental Research	4																									
<p><b>Activities</b>  <b>2 Coastal Environment Research</b></p> <p>2-1 To compile baseline data to understand the tendency of coastal environment          2-2 To collect physicochemical data in barachois          2-3 To enhance the capability of C/P in chemical analysis and data processing          2-4 To formulate coastal water quality guideline          2-5 To produce manuals for coastal environmental monitoring</p>	<p><b>Japanese Inputs</b></p> <p style="text-align: right;">(m/m : man/month)</p> <p><b>1 Long Term Experts</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding-left: 20px;">Team Leader</td> <td style="text-align: right;">60 m/m</td> </tr> <tr> <td style="padding-left: 20px;">Resources Propagation</td> <td style="text-align: right;">60 m/m</td> </tr> <tr> <td style="padding-left: 20px;">Coastal Ecosystem Research</td> <td style="text-align: right;">60 m/m</td> </tr> <tr> <td style="padding-left: 20px;">Coastal Environmental Research</td> <td style="text-align: right;">60 m/m</td> </tr> <tr> <td style="padding-left: 20px;">Coordinator</td> <td style="text-align: right;">60 m/m</td> </tr> </table> <p><b>2 Short Term Experts</b> 13 m/m (14 experts )</p> <p><b>3 C/P Training in Japan</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding-left: 20px;">JFY1995</td> <td style="text-align: center;">1</td> <td style="text-align: right;">JFY1996 2</td> </tr> <tr> <td style="padding-left: 20px;">JFY1997</td> <td style="text-align: center;">3</td> <td style="text-align: right;">JFY1998 2</td> </tr> <tr> <td style="padding-left: 20px;">JFY1999</td> <td style="text-align: center;">3</td> <td style="text-align: right;">JFY2000 2 + (1)</td> </tr> </table> <p><b>4 Expense(Unit: 1,000Japanese Yen)</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding-left: 20px;">Local Cost</td> <td style="text-align: right;">25,597(JFY1995-JFY2000)</td> </tr> <tr> <td style="padding-left: 20px;">Procurement of Equipment</td> <td style="text-align: right;">137,624(JFY1995-JFY1998)</td> </tr> </table>		Team Leader	60 m/m	Resources Propagation	60 m/m	Coastal Ecosystem Research	60 m/m	Coastal Environmental Research	60 m/m	Coordinator	60 m/m	JFY1995	1	JFY1996 2	JFY1997	3	JFY1998 2	JFY1999	3	JFY2000 2 + (1)	Local Cost	25,597(JFY1995-JFY2000)	Procurement of Equipment	137,624(JFY1995-JFY1998)	<p><b>Pre-conditions</b></p> <ul style="list-style-type: none"> <li>• The unexpected weather do not appear.</li> <li>• Budget necessary for conducting Project is secured by Government of Mauritius.</li> </ul>
Team Leader	60 m/m																									
Resources Propagation	60 m/m																									
Coastal Ecosystem Research	60 m/m																									
Coastal Environmental Research	60 m/m																									
Coordinator	60 m/m																									
JFY1995	1	JFY1996 2																								
JFY1997	3	JFY1998 2																								
JFY1999	3	JFY2000 2 + (1)																								
Local Cost	25,597(JFY1995-JFY2000)																									
Procurement of Equipment	137,624(JFY1995-JFY1998)																									
<p><b>Activities</b>  <b>3 Coastal Ecosystem Research</b></p> <p>3-1 To study the distribution of coastal resources, such as, sea grass and mangrove areas          3-2 To design a monitoring system for the coastal ecosystem          3-3 To conduct ecological survey in barachois          3-4 To enhance self-study ability of C/P on coastal ecosystem research          3-5 To study current coastal ecosystem through reviewing scientific literature          3-6 To produce technical reports and scientific publications</p>																										

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Appendix 2 : Chart of Input Japanese Side & Mauritian Side

as of June 2000

A2 - 1 Dispatch of Expert, Procurement of Equipment

Coastal Fisheries Resources and Environment Conservation Project, Mauritius

Scheme	FY	FY1995			FY1996			FY1997			FY1998			FY1999			FY2000												
		month	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12		
Expert Dispatch	Long-term	< Team Leader >	Norihisa ISHIBASHI 95.12.02-97.12.01											-98.12.01			-99.01.25												
		< Resource Propagation >	Kazuhito HIRAMATSU 95.12.02-97.12.01														Hiroshi IWAMOTO 99.01.09-00.11.30												
		< Coastal Ecosystem Research >	Hiroyuki KAWASAKI 95.12.02-98.06.01											-98.06.01			Tomohito SHIMIZU 97.11.17-99.			-99.11.16									
		< Coastal Environment Research >	Aisumu TERAJ 96.02.07-98.02.06														Hiroaki TERASHIMA 98.05.16-00.12.01												
		< Project Coordinator >	Shigeo WATANABE 95.12.02-97.12.01											-98.12.01						Shuichi HARIMA 98.11.14-00.12.10									
	Short-term	< Crab Seed Production >	K. HAMASAKI 96.11.02-96.12.16			< Coral Fish Taxonomy >			H. TERASHIMA 97.05.17-97.06.14			< Coral Ecosystem Ecology >			S. NOJIMA 98.10.27-98.11.24			< Marine Botany >			M. YAWAMOTO 99.09.25-99.10.21			< Coral Reef Area Ecology >			Takada Aug/2000 -		
		< Coastal Environment Monitoring >	H. SATO 97.03.01-97.03.18			< Fisheries Engineering >			T. HOSHINO 97.10.01-97.10.25			< Crab Brood Stock Management >			K. HAMASAKI 98.11.17-99.01.18			< Fish Farming >			R. SANO 99.08.31-99.09.27								
		< Coastal Bacteriology >	K. OGAWA 97.03.23-97.04.21			< Harmful Algae >			Y. FUKUYO 98.02.21-98.03.09			H. NAKATA 99.03.02-99.03.25			< Coastal Zone Management >						< Data Analysis >			Ikenoue Sep/2000 -					
		< Environment Assessment (Residual Pesticide) >										< Environment Assessment (Residual Pesticide) >			H. Sato 00 Mar														
				00.03.14-00.04.07																									
Equipment	Procured Equipment in reply to FORM-A4	▲ 2,095K yen PC, Diving Gears etc. ● 13,000K yen Gaschromatograph Rotary Evaporator etc.			▲ 17,412K yen Track etc. Atomic Absorption Spectrometer ● 10,570K yen Inverted Microscope Mercury Analyzer etc.			▲ 4,506K yen ▲ 3,875K yen ● 12,110K yen Fluorescence Microscope Track etc.			▲ 834K yen Mercury Analyzer etc. Fluorescence Microscope etc. ● 15,892K yen			▲ 6,225K yen Oil Meter, Cartridge Filter Diving Equipment etc. ● 15,499K yen			▲ approx. 2,100K yen PC Projector Gas Chro - spare Parts ● approx. 18,602K yen												
	Accompanied Equipment	● ▲ PC ▲ Under Water Camera etc.			● Test Tube Water Sample Collector, etc			● ▲ MO Drive, etc			▲ ● Glassware Digital Video Camera with UW housing, etc.			▲ MO Drive Digital Camera, etc.			▲ ● Objectives lens GPS, Software etc.												



Appendix 2 : Chart of Input Japanese Side & Mauritian Side

as of June 2000

A2 - 2 Counterpart Training, Local cost sharing, Mauritius budget allocation, etc

Coastal Fisheries Resources and Environment Conservation Project, Mauritius

Scheme	FY month	FY1995				FY1996				FY1997				FY1998				FY1999				FY2000														
		12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10
Counterpart Training in Japan		Project Management B. BOYRAMBOL 96.03.26 - 96.04.11				General Aquaculture C.R. SAMBOO 97.05.20 - 97.06.18				Fish Nutrition O. VENKATASAMI 98.03.17 - 98.04.22				Liberation Technique S.K. KHADUN 99.05.18 - 99.08.03				Environmental Impact Assessment C.V. Chineah 00.05.09-00.06.18																		
		Heavy Metal & Nutrient Analysis V.M. CHOORAMUN 96.09.10 - 96.11.12				Observation of Coastal Resources M.MUNBODH 97.09.01 - 97.09.16				Coastal Biology V MANGAR 98.08.11 - 98.09.29 Nutrient Circulation & Mechanism R.N.B. SOOGUN 98.05.19 - (98.06.30)				Environment Monitoring (Water Quality) J.P.LUTCHMUN 99.09.15 - 99.11.08				Fish culture management technique H. Bhudoye 00.05.16 - 00.08.03 Seed Production S.RAMSAHA 00.03.28 - 00.05.30 Coastal Bacteriology Basant Rai 00/Aug - 00/Sep																		
Local Cost Sharing by JICA		1,680K yen				4,770K yen 2,430K yen				4,020K yen 386K yen				3,780K yen				3,780K yen 449K yen				2,548K yen + 1,776K yen														
Mauritian Budget (FY: July-June)		* Aquaculture Div. 3 C/P																																		
		* Marine Science Div. (Ecosystem) 4 C/P																																		
		* Marine Science Div. (Environment) 3 C/P																																		
	Viricle, Driver, Assistant Staff																																			
	Recurrent Budget (including expences incurred on other project implemented by AFRC)																																			
	Rs. 2 million				Rs. 2.2 million				Rs. 2 million				Rs. 2 million				Rs. 2 million				Rs. 2 million															
JICA Delegation		Consultation Team 96.06/09								Advisory Team 98.06.27-98.07.10								Evaluation Study 00.06.25-00.07.12																		
JICA Leader Meeting		(Tokyo) Mr. ISHIBASHI				(Paraguay) Mr. ISHIBASHI				(Tokyo) Mr. ISHIBASHI				(Tokyo) Mr. IWAMOTO				(Tokyo) Mr. IWAMOTO																		
JICA Coordinator Meeting						(Mexico) Mr. WATANABE								(London) Mr. WATANABE								( ) Mr. HARIMA														

Appendix 3 : Chart of Counterpart Allocation

Coastal Fisheries Resources and Environment Conservation Project, Mauritius

as of June 2000

	FY	Allocation Status						C/P Training in Japan		Remarks		
		FY1995	FY1996	FY1997	FY1998	FY1999	FY2000	Duration	Majour Institute			
		12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11	12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11	12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11	12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11	12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11	12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11					
Management	PERMANENT SECRETARY	B. BOYRAMBOLI										
	M. MUNBODH (PFO)	Project Management								96.03.26 - 96.04.11	Okinawa Suishi, Kankyo Eisei Shikenjyo	
	M.I. JEHANGEER (DSO)	Observation of Coastal Resources								97.09.01 - 97.09.16	JASFA	
	V. CHINEAH (DSO)	General Aquaculture								00.05.09 - 00.06.18	OECC	
	C.R. SAMBOO (DSO)	Environment Impact Assessment								97.05.20 - 97.06.18	JASFA, Okinawa SaibaiGyugyou Ctr	
	<u>N. ISHIBASHI</u> <u>H. IWAMOTO</u> <u>S. WATANABE</u> <u>S. HARIMA</u>	*****										
Resources Propagation	D. MAUREE *	<Off-Duty for Oversea Study in UK> (Transferred to AdminiManagement Section)									Moved	
	S. RAMSAHA *	Seed Production								00.03.28 - 00.05.30	Ehime, Okinawa, Kagoshima, JA	almost on schedule
	S. KHADUN *	Liberation Technique								99.05.18 - 99.08.03	Shizuoka Suishi, JASFA-Hakata	almost on schedule
	O. VENKATASAMI *	Fish Nutrition								98.03.17 - 98.04.22	Kagoshima Univ., Okinawa Suishi	almost on schedule
	<u>K. HIRAMATSU</u> <u>T. SHIMIZU</u>	*****										
Ecosystem Research	N.C. PAUPIAH *	<Off-Duty for Oversea Study in UK>									Oversea study 1yrs	
	R. MOOTIEN PILLAY *	<Off-Duty for Oversea Study in Australia>									Oversea study 2yrs	
	J.I. MOSAHEB *	<Off-Duty for Oversea Study in Australia>									almost on schedule	
	V. MANGAR *	Coastal Biology								98.08.11 - 98.09.29	Ryukyu Univ., Kyushu Univ-Ama	almost on schedule
	<u>H. KAWASAKI</u> <u>H. TERASHIMA</u>	*****										
Environment Monitoring	V.M. CHOORAMUN *	Heavy Metal & Nutrient Analysis								96.09.10 - 96.11.12	Ehime Univ., Okinawa, Chuo-Sui-Ke	n leave for 8months
	P. NEERMUL *	Residual Pesticide & Chlorophyll								96.09.10 - 96.11.12	Chuo Suiken, Ehime Univ., Okin	almost on schedule
	R.N.B. SOOGUN *	Nutrient Circulation & Mechanisma								98.05.19 - 98.06.30	Hiroshima Univ., Tokyo Univ of	almost on schedule
	J.P. LUCHMUN *	Environment Monitoring (Water Quarity)								99.03.15-99.11.08	<Group Training Course>	almost on schedule
	<u>A. TERAI</u>	*****										

(Note 1) Personnel allocation is discribed by bar-chart. ( Allocation JICA Training Course )



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Appendix 4 : List of Provided Machinery and Equipment

as of June 2000

(Equipment worth more than US15,000 per unit)

Coastal Fisheries Resources and Environment Conservation Project, Mauritius

Year	#	Name of Equipment (Manufacturer *Model)	Price (1,000Yen)	Qty	Allocation	Utilization Status	Maintenance Status	Remarks
FY1995	1	Gaschromatograph (SHIMAZU 14A)	2,967	1	Study Room 1	in use	good	nessesary regent has been collected
FY1996	2	Atomic Absorption Spectrometer (VARIAN Spectr AA200 Double Beam)	5,028	1	Chemistry Lab.	in use	good	
FY1996	3	High Performance Liquid Chromatography (HEWLETT PACKARD)	7,459	1	Study Room 1	in use	good	gard-culm has been set
FY1996	4	4WD (TOYOTA Land Cruiser 2.8L Diesel)	2,792	1	Field of AFRC	in use	good	
FY1996	5	Mercury Analyzer (Nippon Instruments RA-2P20)	1,655	1	Chemistry Lab.	in use	good	
FY1997	6	Fluorescence Microscope	2,340	1	Marine Bacteriology Lab.	in use	good	
FY1997	7	Track (TOYOTA)	2,700	1	Field of AFRC	in use	good	
FY1998	8	Mercury Analyzer (with Accessories)	3,632	1	Chemistry Lab.	in use	good	
FY1998	9	Fluorescence Microscope	2,300	1	Aqua culture Lab.	in use	good	
FY1999	10	Oil Meter	1,424	1	Chemistry Lab.	in use	good	

Appendix 4 : List of Provided Machinery and Equipment

as of June 2000

(Equipment worth more than US900 and less than US15,000 per unit)

Coastal Fisheries Resources and Environment Conservation Project, Mauritius

Year	#	Name of Equipment (Manufacturer - Model)	Supplied	Disposed	Remain	Utilization Status	Maintenance Status	Reason for the Disposal
FY1995	101	Live Fish Tank (ARCE : 1000 Litter)	2	0	2	in use	good	
FY1995	102	Artemia Incubation Tank (ARCE : SBR-500)	6	0	6	in use	good	
FY1995	103	Shaker (Ikemoto Rika : 67-305)	1	0	1	in use	good	
FY1995	104	Rotary Evaporator (SIBATA : R-124)	1	0	1	in use	good	
FY1995	105	Ultra Pure Water System (Millipore : M111-Q SP TOC)	1	0	1	in use	good	
FY1995	106	Reagent Storage Box (IUCHI : T-1)	1	0	1	in use	good	
FY1995	107	Ultrasonic Washer (SHARP : SILENT SONIC UC-602)	1	0	1	in use	good	
FY1995	108	Sterilizer (SIBATA : ST-450)	3	0	3	in use	good	
FY1995	109	Desk-Top Computer (FUJITSU : FMV 5DH1& DH6, Power Macintosh : 7200/90)	3	0	3	in use	almost finish the life	
FY1995	110	Laser Printer (CANON : LPB-A405Jr, Macintosh : Lazer Writer Select)	2	0	2	in use	good	
FY1995	111	Lap-Top Computer (COMPAC : Contura 410C/V)	1	0	1	in use	almost finish the life	
FY1995	112	Kuderna Danish Concentrator (SIBATA 8123-1)	1	0	1	in use	good	
FY1996	113	Cylinder for Scuba Diving (SHERWOOD : Aluminum 12Litter)	5	0	5	in use	good	
FY1996	114	Moji Net (ARCE : N44-105)	2	0	2	in use	good	
FY1996	115	Moji Net (ARCE : N44-140)	2	0	2	in use	good	
FY1996	116	Moji Net (ARCE : N44-200)	2	0	2	in use	good	
FY1996	117	Shaker (Ikemoto Rika, 67-302)	1	0	1	in use	good	
FY1996	118	Hotplate (Asahi Rika Seisakusho : APS-500)	2	0	2	in use	good	
FY1996	119	Inverted Microscope (Nikon TMS-F12)	1	0	1	in use	good	
FY1996	120	Plankton Net (ARCE : DIN 130)	1	0	1	in use	good	
FY1996	121	PH/ion Meter (TOHA DENPA KOGYO : HM-12P)	1	0	1	in use	good	

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Appendix 4 : List of Provided Machinery and Equipment

as of June 2000

(Equipment worth more than US900 and less than US15,000 per unit)

Coastal Fisheries Resources and Environment Conservation Project, Mauritius

Year	#	Name of Equipment (Manufacturer - Model)	Supplied	Disposed	Remain	Utilization Status	Maintenance Status	Reason for the Disposal
FY1996	122	Vac Elute Tubing Set (GL Science 6030-18012)	1	0	1	in use	good	
FY1996	123	Vac Manifold Aspirator (GL Science : 6030-12220)	1	0	1	in use	good	
FY1997	124	Portable Water Checker	2	0	2	in use	good	
FY1997	125	Vandorn Water Sampler	2	0	2	in use	good	
FY1997	126	Digital Balance	1	0	1	in use	good	
FY1997	127	Root Air Brower	1	0	1	in use	good	
FY1997	128	FRP Water Tank	8	0	8	in use	good	
FY1997	129	Flexible Vinyl Hose (inner 25mm, outer 31.6mm, 400m)	1	0	1	in use	good	
FY1997	130	Flexible Vinyl Hose (inner 31mm, outer 38mm, 200m)	1	0	1	in use	good	
FY1997	131	Dissolved Oxygen (DO) Meter	1	0	1	in use	good	
FY1997	132	Plankton Net Material (Opening 60micron, W102cm, L20m)	1	0	1	in use	good	
FY1997	133	PH Meter	1	0	1	in use	good	
FY1997	134	Air Brower (200W, Max 300L per mints)	2	0	2	in use	good	
FY1997	135	Video Camera	1	0	1	in use	good	
FY1997	136	Desk-Top Computer (FUJITSU FMV 5DH1& DH6, Power Macintosh 7200/90)	2	0	2	in use	good	
FY1997	137	Under Water Illuminometer	1	0	1	in use	good	
FY1997	138	Reagent Refrigerator	2	0	2	in use	good	
FY1998	139	Dissolved Oxygen (DO) Meter (F-102-5)	1	0	1	in use	good	
FY1998	140	Plankton Net (DIN 100), 40M	1	0	1	in use	good	
FY1998	141	Plankton Net (11XX), 20M	1	0	1	in use	good	
FY1998	142	Net Cage (240k) W100CM, 151.5M	3	0	3	in use	good	

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Appendix 4 : List of Provided Machinery and Equipment

as of June 2000

(Equipment worth more than US900 and less than US15,000 per unit)

Coastal Fisheries Resources and Environment Conservation Project, Mauritius

Year	#	Name of Equipment (Manufacturer - Model)	Supplied	Disposed	Remain	Utilization Status	Maintenance Status	Reason for the Disposal
FY1998	143	Net Cage (160k) W100CM, 151.5M	3	0	3	in use	good	
FY1998	144	Net Cage (90k) W100CM, 151.5M	3	0	3	in use	good	
FY1998	145	Stereoscopic Zoom Microscope (Nikon SMZ-U-3)	1	0	1	in use	good	
FY1998	146	Desiccators (BIGDRY B-2)	2	0	2	in use	good	
FY1998	147	UV Lump (UVF-250)	3	0	3	in use	good	
FY1998	148	Single Reflect Lens Camera (Nikon F90XD)	2	0	2	in use	good	
FY1998	149	Under Water Camera Housing (NEXUS for NIKON F90X)	1	0	1	in use	good	
FY1998	150	Under Water Speed Light (SB-104)	1	0	1	in use	good	
FY1998	151	Photo Micrographic (U-III-35-PL 1)	1	0	1	in use	good	
FY1998	152	UPS	1	0	1	in use	good	
FY1999	153	IC Board of Water Quality Analyzer	1	0	1	in use	good	
FY1999	154	Refrigerator	1	0	1	in use	good	
FY1999	155	DeskTop Computer (Acer Power 6100)	4	0	4	in use	good	
FY1999	156	Air/Humidity Conditioner	1	0	1	in use	good	
FY1999	157	Filter Tank fot Aquarium	1	0	1	in use	good	
FY1999	158	Source Lump for DR2000	1	0	1	in use	good	
FY2000	159							
FY2000	160							
FY2000	161							

5b

## 1. Resources Propagation

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### 1-1. Seed production

#### < Objective >

Development of the seed production techniques for mangrove crab, sea bream and black tiger shrimp.

#### < Activities >

##### **Mangrove crab** (*Scylla serrata*)

- Identify the reasons of mass mortality and develop the control methods in early stages of larvae.
- Improve the live feed culture techniques.
- Feed experiment to develop the feeding regime.
- Study the appropriate water salinity.
- Prepare a manual on seed production.

##### **Sea bream** (*Rhabdosargus sarba*)

- Identify the reasons of mass mortality and develop the control methods in early stage of larvae.
- Develop a bone staining technique.
- Effect trial to prevent fish deformation (on going).
- Feed experiment to develop a new feed regime.

##### **Black tiger shrimp** (*Penaeus monodon*)

(Terminated in 2nd year with achievement the initial target )

- Improve feed regime.
- Prepare a manual.

#### < Achievements >

##### **Mangrove crab** (*Scylla serrata*)

- Some 4,500 crab juveniles (C1 stage) were produced. ( target : 10,000 crab/ year)
- Maximum 500 crab/ kl produced.
- Fungal Disease was controlled.
- Mass culture of live feed organisms was developed.

##### **Sea bream** (*Rhabdosargus sarba*)

- Some 100,000 (fries/year) were produced. (target: 200,000 fries/year)
- Feed regime was being established.
- Oodinium disease was the main reason for mass mortality, a methodology to control the disease was developed.
- Bone staining method was established.
- Different techniques were tried to prevent deformation in fish. (on going)

##### **Black tiger shrimp** (*Penaeus monodon* , terminated in 2nd year)

- 538,000 juveniles were produced in second year. (target: 500,000 juveniles/year)
- A feed regime was established.

#### < Evaluation >

##### **Mangrove crab** (*Scylla serrata*)

A basic seed production technique has been established and acquired by the counterparts. The technique is being improved.

Some 4,500 crab juveniles (C1) were produced in the hatchery. The target number (10,000 juvenile/year) was not achieved. Even if the target number was not achieved this result was considered to be satisfactory.

If AFRC succeeds with this technology it could be transferred to other tropical and sub-tropical countries.

**Sea bream (*Rhabdosargus sarba*)**

The mass seed production technique was developed, but the quality of fries needs to be improved (many deformed fish were observed).

**Black tiger shrimp (*Penaeus monodon*)**

The seed production technique has already been acquired and the target number was achieved in second year. This technical cooperation was ended in 1998, as it was agreed on the minute signed on 7 July 1998 with the recognition of its acquired technique.

**1-2. Barachois study**

**1-2-1. Release (extensive culture)**

**< Objective >**

Acquirement of suitable release (extensive culture) technique.

**< Activities >**

**Mangrove crab (*Scylla serrata*)**

- Transfer the technique of juvenile rearing to counterparts.
- To carry out the release experiment in barachois.

**Sea bream (*Rhabdosargus sarba*)**

- Marking experiment.
- Trial a new release method ("Kaitsuke").
- Release experiment in the lagoon.

**Black tiger shrimp (*Penaeus monodon*)**

- Marking experiment by tail cut method.
- Extensive culture trial in barachois
- Release experiment by tail cut method.

**< Achievements >**

**Mangrove crab (*Scylla serrata*)**

- Crabs were released in barachois after rearing in the net pen.
- Feeding regime was tried.
- Technical reports on rearing and release were prepared.
- 2,217 crab juveniles were released in 8 batches in barachois.

**Sea bream (*Rhabdosargus sarba*)**

- 50,780 fry were released in 10 batches in barachois and lagoon.
- Seining operation showed presence of released fish in the lagoon at Albion. In addition data collected indicated the movement pattern of marked fish.
- Technical reports on release and recapture were prepared.

**Black tiger shrimp (*Penaeus monodon*)**

- According to the record of recapture, by seining, the growth rate of released shrimps was determined.



- In July 1997, 22,770 juveniles of 4.6g average body weight were released in Butte a l'Herbe barachois. Sampling was effected after release. Shrimps were recaptured within 4 months after the release.
- 130,000 marked shrimp (2.5~4.7g average body weights) were released in the lagoon at Grand Sable and Bambous Virieux lagoon from August to December 1997. Up to March 1998, 39 shrimps were captured.
- 155,098 shrimp juveniles were released in the barachois and lagoon

< Evaluation >

**Mangrove crab** (*Scylla serrata*)

The investigation on mangrove crab release did not give reliable result, because the number of crab release was small. However, the release technique was acquired by the counterpart. Data is being collected to analyse the crab stock.

**Sea bream** (*Rhabdosargus sarba*)

The movement pattern was found to be similar at different points of release. Many released fish were found in the barachois and the river mouth at Albion.

Some unmarked young fish were caught in this barachois. This indicated the possibilities of reproduction of sea bream occurring in the wild.

Studies on movement pattern growth and reproduction are necessary to evaluate the success of the resource propagation.

**Black tiger shrimp** (*Penaeus monodon*)

Marking method practice in Japan was used locally. Some marked shrimps were caught around released area. This marking and release experiment is the first time trial in the world.

1-2-2. Culture

< Objective >

Development of pen and cage culture techniques in barachois.

< Activities >

**Sea bream** (*Rhabdosargus sarba*)

- Culture experiment in pen and cage in barachois.
- Culture trials at different stocking density and different feed experiments.
- Develop grow-out pellets for sea bream.
- Distribution of fries to barachois.
- General monitoring of parameters in barachois.

**Black tiger shrimp** (*Penaeus monodon*)

- Conduct culture experiment in pen and cages in barachois.
- Effect semi-intensive culture experiment in pods at AFRC.
- Distribution of shrimp juveniles to farmers.
- Supervision of intensive culture trial of shrimp in closed water system been conducted by a promoter.

< Achievements >

**Sea bream** (*Rhabdosargus sarba*)

- Technical reports were prepared.
- 72,000 fingerlings were distributed to barachois and Reunion Island.
- The sea bream grow-out pellet was being tested.

**Black tiger shrimp** (*Penaeus monodon*)



- A technical report was prepared.
- 91,000 shrimp juveniles were distributed to barachois.
- Intensive culture trial was successful with a survival rate of more than 60%.

< Evaluation >

**Sea bream** (*Rhabdosargus sarba*)

Since all the barachois are located far from AFRC, it was difficult to provide daily management. It was also observed that barachois owners did not manage culture as per recommendation. In these circumstances it would be desirable for AFRC to operate its own barachois. This will allow the implementation of culture experiments in pen and cage culture under sound and scientific management by its staff.

**Black tiger shrimp** (*Penaeus monodon*)

Culture technology needed to be transferred to promoter for the development of shrimp culture in Mauritius.

**1-2-3. Basic research and transplantation**

< Activities >

- Study of bivalves ecology.
- Prepare list of edible bivalves.
- Transplantation trial of "Betai" (*Asaphis vilaciens*).

< Achievements >

- Listed fourteen edible bivalves.
- Carried out two transplantation trials.

< Evaluation >

This project had to be terminated because other projects took priority over it.

**1-3. Brood stock study**

< Objective >

Finding suitable inducement spawning method.

< Activities >

**Black tiger shrimp** (*Penaeus monodon*)

- Trials to formulate suitable maturation diet.
- Eye stalk ablation experiments.
- Artificial insemination experiments.

**Mangrove crab** (*Scylla serrata*)

- Collection of spawners from barachois.
- Improve brood stock management.
- Redesign brood stock tank.
- Selection of good spawners.

< Achievements >

**Black tiger shrimp** (*Penaeus monodon*)

- Eye stalk ablation and artificial insemination manual was prepared.
- The suitable feed regime for maturation was being developed.

**Mangrove crab (*Scylla serrata*)**

- Regular collection of spawners.
- All spawners were oviposited in the brood stock tank.
- The survival rate of spawners was improved.

**< Evaluation >**

**Black tiger shrimp (*Penaeus monodon*)**

The technique to induce maturation was successfully transferred to the counterparts and no further assistance was required since July 1998.

**Mangrove crab (*Scylla serrata*)**

The spawners were successful in producing a large number of good quality larvae to carry out the seed production and achieve the target set.

**1-4. Technical manuals**

**< Objective >**

Preparation of the technical manuals on the seed production, culture, release and brood stock rearing techniques of above species.

**< Activities >**

Prepare the technical manuals (on going).

**< Achievements >**

The following technical manuals were prepared:

- Rotifer culture (on mass culture and low season)
- Seed production of black tiger shrimp (*Penaeus monodon*)
- Eye stalk ablation and artificial insemination of black tiger shrimp (*Penaeus monodon*)
- Seed production of sea bream (*Rhabdosargus sarba*)
- Brood stock management of mangrove crab (*Scylla serrata*)
- Aquaculture development in Mauritius (on going)

**< Evaluation >**

The manuals were being prepared for officers of aquaculture division as a technical reference aiming to assist the smooth implementation of any projects.



## ( Annex - Tables 1-4, Resources Propagation )

Table 1. Total production number on seed production on the project.

Species	Unit	1st year	2nd year	3rd year	4th year	5th year
Black tiger shrimp	Thousand	150	538			
Sea bream	Thousand	34	198	85	93	(433)*
Mangrove crab	Individual	186	0	1,600	2,951	4,486

\* The data obtained by June 2000. Sea bream in 5th year was shown as 10 days larvae.

Table 2. Released fish, crab and shrimp (\* = released in lagoon)

Place	Date	Species	Number	Average weight (g)	Average carapace width (mm)
Beau Rivage	30/9/97	Sea bream	13,500	0.4	
Montagu	1/10/97	Sea bream	13,000	0.4	
St Francois	12/11/97	Sea bream	3,000	0.4	
Rouillard	3/12/97	Sea bream	2,000	1.7	
Melville	22/1/98	Sea bream	3,100	9.0	
Albion *	18/12/98	Sea bream	1,200	115.2	
Albion *	26/5/99	Sea bream	1,700	106.4	
Montagu	23/8/99	Sea bream	2,000	55.4	
Montagu	24/8/99	Sea bream	2,000	55.4	
Albion *	24/11/99	Sea bream	488	189.0	
Albion *	8/3/00	Sea bream	525	110.0	
Choisy	12/4/00	Sea bream	5,000	3.0	
Oozeerally	21/4/00	Sea bream	5,100	3.9	
Albion *	25/5/00	Sea bream	167	150.3	
<b>Total</b>			<b>50,780</b>		
Nozaic	25/2/97	Crab	8	4.4	36.3
Le Blanc	20/3/97	Crab	7	18.1	44.3
Rouillard	7/5/98	Crab	323		9.6
Butte a L'Herbe	22/5/98	Crab	132		12.0
Rouillard	14/12/99	Crab	305		12.3
Nozaic	5/1/00	Crab	996	0.4	9.5
Virginia	22/2/00	Crab	396	0.6	15.9
Bocambous	5/5/00	Crab	50		12.5
<b>Total</b>			<b>2,217</b>		
Butte a L'Herbe	2/7/97	Shrimp	14,151	4.6	
Butte a L'Herbe	4/7/97	Shrimp	8,619	4.6	
Grand Sable *	26/8/97	Shrimp	10,000	2.0	
Grand Sable *	28/8/97	Shrimp	11,200	2.0	
Grand Sable *	1/9/97	Shrimp	12,600	2.0	
Grand Sable *	3/9/97	Shrimp	16,200	2.0	
Bambous Virieux *	9/9/97	Shrimp	13,765	2.3	

## Appendix 5

Bambous Virieux *	11/9/97	Shrimp	10,135	2.2
Bambous Virieux *	15/9/97	Shrimp	9,019	2.6
Bambous Virieux *	17/9/97	Shrimp	10,115	3.0
Bambous Virieux *	19/9/97	Shrimp	9,555	2.9
<i>Bambous Virieux *</i>	23/9/97	Shrimp	7,098	2.9
Bambous Virieux *	13/11/97	Shrimp	8,698	4.7
Bambous Virieux *	18/11/97	Shrimp	6,997	4.7
Bambous Virieux *	10/12/97	Shrimp	6,946	4.9
<b>Total</b>			155,098	

Table 3. Distribution of sea bream fingerings to barachois.

Place	Type	Date	Number	Average body weight (g)	Average total body length (mm)
Beau Rivage	Cage	26/1/96	800	6.0	
Choisy	Cage	26/1/96	1,350	6.0	
Montagu	Cage	26/1/96	1,000	6.0	
Nozaic	Cage	16/9/96	620	0.5	
Montagu	Cage	18/9/96	1,975	0.9	
Montagu	Cage	16/1/97	2,000	2.0	
Montagu	Cage	17/1/97	2,100	2.0	
Nozaic	Cage	22/1/97	3,900	20.4	46.2
Rouillard	Cage	3/12/97	2,000	1.7	
Oozeerally	Cage	4/4/97	2,000	13.7	66.7
Virginia	Pen	5/2/97	2,405	5.5	46.2
Beau Rivage	Cage	10/3/97	3,020	6.0	
Virginia	Pen	12/2/97	2,000	5.5	50.8
St Francois	Cage	12/11/97	3,000	0.4	
Beau Rivage	Cage	13/2/98	1,500	8.0	24.5
Beau Rivage	Pen	17/2/98	1,658	8.2	
Belmont	Cage	11/8/98	1,100	52.5	95.0
Reunion		10/12/98	10,000	1.5	
Beau Rivage	Cage	23/3/99	3,000	14.7	
Montagu	Cage	25/3/99	3,000	14.7	
Belmont	Cage	30/4/99	2,050	15.0	
Beau Rivage	Cage	22/7/99	1,200	24.1	109.0
Reunion		8/9/99	6,000	61 days old	
Beau Rivage	Cage	2/2/00	5,000		
Beau Rivage	Cage	8/2/00	5,000		
Beau Rivage	Cage	15/3/00	2,500		
Beau Rivage	Cage	31/3/00	2,500		
<b>Total</b>			72,678		

Table 4. Distribution of shrimp juveniles.

Place	Type	Date	Number	Average body weight (g)
Bocambous	Cage	5/12/95	1,764	1.7
Choisy	Cage	5/12/95	2,120	1.7
Montagu	Cage	5/12/95	1,941	1.7
Choisy	Cage	26/1/96	2,120	1.7
Le Blanc	Pond	21/5/96	7,250	1.2
Le Blanc	Pond	6/8/96	3,577	1.2
Bocambous	Cage	8/8/96	3,150	1.2
Le Blanc	Pond	15/8/96	2,600	1.3
Montagu	Cage	23/8/96	3,620	1.2
Le Blanc	Pond	5/9/96	1,225	2.0
Butte a L'Herbe	Cage	29/10/96	500	10.0
Poudre d'Or	Pen	29/10/96	1,000	10.0
Le Blanc	Pond	1/4/97	5,034	4.3
Le Blanc	Pond	14/4/97	4,250	6.0
Montagu	Cage	24/4/97	2,000	6.2
Butte a L'Herbe	Pond	29/4/97	1,000	6.1
Butte a L'Herbe	Cage	29/4/97	1,000	6.1
Oozeerally	Cage	16/5/97	3,190	
Le Blanc	Pond	23/5/97	3,902	3.1
Le Blanc	Pond	27/5/97	5,170	2.8
Montagu	Cage	8/7/97	2,200	4.6
Montagu	Cage	8/7/97	2,469	7.4
Le Blanc	Pond	2/10/97	15,594	2.3
Gland Gaube **	Pond	18/6/99	50	4.1
Gland Gaube **	Pond	4/8/99	4,179	4.9
Gland Gaube **	Pond	4/8/99	1,789	1.0
Gland Gaube **	Pond	13/8/99	93	0.2
Gland Gaube **	Pond	24/2/00	8,363	2.2
<b>Total</b>			<b>91,150</b>	

Grand Gaube \*\*: A private pond run by a promoter (Mr. Lim)

## 2. Coastal Environment Research

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### 2-1. Preparation (Plan, collection of information, preparation of analysis) Achievement

#### < Objectives >

#### Establishing initial set-up for regular monitoring

#### < Activities >

- Site visits were effected in coastal areas to plan monitoring program.
- Eight existing sites were reconsidered. These sites were selected by CIDA (Canadian International Development Agency) for coastal environment monitoring which was conducted during the period 1991 to 1994.
- General information on environment monitoring was collected from Central Water Authority, Mauritius Sugar Industry Research Institute(MSIRI), National Environmental Laboratory and University of Mauritius.
- Set up of new equipment received from JICA (Japan International Cooperation Agency) was done for analysis.

#### < Achievement >

- Monitoring on the eight existing sites was continued as regular sites.
- Equipment were set up in the chemistry laboratory. Auto-analyzer, atomic absorption spectrophotometer (AAS), gas chromatograph (GC) and high performance liquid chromatograph (HPLC) were also installed.
- Separate rooms were made for heavy metal and bacteriological analysis to avoid contamination.
- Necessary information was collected from related organization.

#### < Evaluation >

Preparation for the activity was completed as scheduled and implementation started in time.

### 2-2. Coastal environment monitoring

#### < Objectives >

#### Compiling baseline data to understand the tendency of coastal environment

#### < Activities >

- Measurement method and its reliability were checked for each physico-chemical parameter.
- Reproducibility was checked for dissolved oxygen (DO), chemical oxygen demand (COD) and nutrients (nitrate-nitrogen, phosphate) from samples collected at the monitoring sites.
- Coefficient correlation between concentration and absorbance in a series of standard solution was checked each time for the analysis that requires calibration.
- Water temperature, pH, salinity, DO, COD and nutrients were monitored at the monitoring sites including four additional sites (The number of present regular monitoring site is twelve). Extra sites were also sampled.
- The levels of heavy metals (total mercury, cadmium, copper, lead and zinc) were determined on 18 water samples collected from harbour and estuaries.
- The levels of organochlorine pesticides and PCBs were determined on 9 marine fauna samples once only during the visit of short-term expert. The levels of atrazin (19 samples), diuron (19 samples) and hexazinone (8 samples) were determined.

Appendix 5

Coastal Environment Monitoring 1996

Regular Monitoring		Barachois Study	Extra Survey
Anse la Raie	07 Feb,08 May,03 Jul,27 Nov,	Montague 19 Sep,26 Nov,	Bain Des Dames : 27 Mar
Balaclava	24 Apr, 12 Jun, 08 Aug , 04 Dec,	Choisy 29 Oct	Flic en Flac 23 Jul
Bambous Vieux	14 Feb, 04 Apr, 20 Jun, 04 Sep,	Nozaic 12 Dec	Tombeau Bay 24 Jul,20,25 Sep,27 Nov,
Bel Ombre	06 Mar, 05 Jun,28 Aug,16 Oct, 13 Dec,	Humbert 15 Oct, 17 Dec	Grand Baie 07,09 Aug
Ile Aux Benitiers	17 Jan, 10 Apr, 26 Jun,11 Sep,13 Nov		Harbour 20 Dec
Pointe aux Sable	28 Feb, 15 May,10 Jul,04 Oct		
Trou Aux Biches	10 Jan, 14 Mar, 22 May, 14 Aug,23 Oct		
Trou D'eau Douce	31 Jan, 27 Mar, 29 May, 31 Jul,10 Oct		

Regular sites; 37, Extra sites;9, Barachois; 6, Total;52

Coastal Environment Monitoring 1997

Regular Monitoring		Barachois Study	Extra Survey
Anse la Raie	26 Feb, 14 May, 13 Aug, 10 Dec	Montague 30 Jan, 10 Apr, 17 Jul, 18 Sep	Albion 28 Jan, 23 Jun, 22 Jul, 16 Sep, 20 Oct, 18 Nov,17 Dec
Balaclava	19 Mar, 21 May, 06 Aug, 26 Nov	Butte a l'herbe 14 Jan Beau Rivage 27 Feb	
Bambous Vieux	12 Feb,23 Apr, 16 Jul, 19 Nov	Humbert 4 Mar Bocambous 20 Mar	Tombeau Bay 5 Feb, 26 Mar,25 Jun, 27 Aug,
Bel Ombre	9 Apr, 11 Jun, 4 Sep, 04 Dec	Leblank 14 Aug Virginia 04 Sep	
Ile Aux Benitiers	19 Feb, 7 May, 23 Jul, 08 Oct	Mahebourg 09 Oct Roillard 13 Nov	Harbour 5 Mar, 18 Jun, 12 Nov
Pointe aux Sable	9 Jan, 24 Mar (FM), 28 May, 17 Sep	Melville 04 Dec	Pereybere 25 Jun, 01 Jul
Trou Aux Biches	29 Jan,16 Apr, 09 Jul, 05 Nov		
Trou D'eau Douce	15 Jan, 2,3 Apr, 02 Jul, 24 Sep		

FM: Fish Mortality

Regular sites; 40 including Harbour and Tom beau bay, Extra sites;9, Barachois; 13, Total;62



## Coastal Environment Monitoring 1998

Regular Monitoring		Barachois Study
Anse la Raie	Apr08, Jul22, Nov11	Beau Rivage : Jan15, Apr16, Jul15, Oct21 St. Francois: Feb19, Ile aux Chats : Mar18 Belmont: May28, Choisy : Jun25
Balaclava	Jan14, Jun03, Sep16	
Bambous Vieux	Apr01, Aug12, Nov10	Extra Survey
Bel Ombre	Apr27, Jul15, Sep30, Dec16	Albion River: Jan29, Feb17, Mar16, May27, Jul14, Aug25, Sep22, Oct20, Nov17, Dec 29
Harbour	Mar26, Jul08, Sep29	Pointe Moyenne : Jan08, Jan 20 Bain des Dames : Feb 02, Feb 04, Feb18, Oct 28, Nov23
Ile Aux Benitiers	Mar 04, Jun17, Oct7, Dec 2	Saint Felix : Feb19, 18 Mar, Apr27, May14, Jul01, Aug18, Sep11, Oct13, Dec 9
Pointe aux Sable	Jan21, May21, Aug26, Oct28	Mer Rouge/ Port Franc Apr22
Tom beau Bay & Bird sanctuary	Jan07, May06, Jul27, Oct6	Roche Bois : Apr23 Vieux Grand Port : May22
Trou Aux Biches	Mar11, Jun24, Sep23, Nov25	Ile aux Cerfs : Oct14, Oct21, Oct27, Dec 3
Trou D'eau Douce	Feb 18, Jun10, Sep10, Nov18	Belle Mare - Algae : Nov27 Riche en Eau: Oct 09, Pointe aux Sables Oct 30

Regular sites; 46, Extra sites; 26, Barachois; 8, Total; 80

## Coastal Environment Monitoring 1999

Regular Monitoring		Barachois Study
Anse la Raie	22 Feb, 24 May, 26 Jul, 20 Sep, 22 Nov	Beau Rivage : 11 Feb, 24 May, 25 Oct (Mid tide 1, High tide, Mid tide2, Low tide)
Bambous Virieux	18 Feb, 10 May, 19 Jul, 27 Sep, 07 Dec	
Bel Ombre	19 Apr, 21 Jun, 09 Aug, 04 Nov	Extra Survey
Harbour	06 Jan, 12 Apr, 14 Jun, 30 Aug, 29 Nov	St Felix: 01 Mar, 19 May
Ile Aux Benitiers	15 Mar, 31 May, 02 Aug, 13 Oct, 20 Dec	Mare aux Vacoas: 23 Mar (6:00 AM, 12:00-14:30,
Pointe aux Sable	08 Feb, 30 Jun, 30 Aug, 04 Oct, 09 Dec	24 Mar (7:00 - 10:00, 22:00), 25 Mar (4:00 AM), 01 Apr, 06 Apr, 13 Apr, 27 Jul, 18 Oct
Tom beau Bay & Bird sanctuary	13 Jan, 05 Apr, 24 May, 07 Jun, 16 Aug, 20 Oct, 20 Dec	Mare longue 26 Mar, La ferme 27 Mar, 06 Apr
Trou Aux Biches	27 Jan, 26 Apr, 05 Jul, 06 Sep, 15 Nov	Piton du Millieu 13 Apr, 27 Jul, 18 Oct
Trou D'eau Douce	03 Feb, 03 May, 12 Jul, 13 Sep, 08 Nov	La Nicoliere 13 Apr, 27 Jul, 18 Oct
		Albion 12 May, 07 Jul
		Roche Bois 26 May
		Choisy barachois 17 Jun

Regular sites; 46, Extra sites;29, Barachois; 6, Total;81

Water sampling for heavy metal and residual pesticides: 05, 06 August, 14, 17 December

Balaclava was removed from regular monitoring sites.

## Coastal Environment Monitoring 2000

As of Jun 2000

Regular Monitoring		Extra Survey
Anse la Raie	21 Feb, 07 Jun	Reservoirs (La Nicoliere, Piton du milieu, Mare aux Vacoas) 26 Jan Poste La Fayette 17 March Trou aux Biches (Extra) 28 Mar Pointe aux Sables (Extra) 28 Apr St Felix 03 May
Bambous Virieux	06 Mar	
Bel Ombre	28 Feb	
Harbour	23 Feb, 27 Jun	
Ile Aux Benitiers	15 Mar,	
Pointe aux Sable	22 Mar, 27 Jun	
Tom beau Bay & Bird sanctuary	05 Jan, 01 Mar, 08 Mar, 19 Apr, 17 May, 21 Jun, 28	
Trou Aux Biches	02 Feb, 10 May	
Trou D'eau Douce	24 Jan, 29 Mar	
Poudre D'Or	11 Jan, 09 Feb, 09 Mar, 27 Mar, 10 Apr, 14 Apr, 18 Apr (11:00, 19:00), 03 May, 13 May, 18 May, 01 Jun, 14	
Baie du Dame	26 Apr, 27 Jun	
Grand bay	23 Mar, 03 Apr, 10 May,	

Regular sites; 39, Extra sites; 5, Total; 44

Water sampling for heavy metal and residual pesticides: 29, 30 May

Poudre D'or, Baie du Dame and Grand bay was added to regular monitoring sites.

#### < Achievement >

- The analytical methods for the following physico-chemical parameters were changed to improve accuracy and reliability.
  - 1) DO: Measurement by DO meter → Winkler-sodium azide modification method
  - 2) Salinity: Refractometer → Salinometer and conductivity meter
  - 3) Amount of organic substances: BOD → COD (Alkaline permanganate method) ; This method is more suitable for the measurement in seawater samples.
  - 4) Nitrate - nitrogen: HACH DR/2000 → Cadmium reduction method - Detection limit was lowered to 0.01 mg/l. Accuracy and reliability have greatly improved, however this method is applied only to the samples collected from monitoring sites due to lack of manpower.

Auto-analyzer is only applied when many samples are collected.

5) Phosphate: HACH DR/2000 → Ascorbic acid method - Applied only to the sample collected from monitoring sites as often as possible. Auto-analyzer is applied only when many samples are collected.

- High reproducibility was obtained on the measurement of DO, COD and nutrients (cadmium reduction method and ascorbic acid method).
- A high correlation coefficient (more than 0.999) was obtained between the concentration and absorbance each time when calibration was effected.
- During the mid term evaluation the program for oil hydrocarbon was modified to start in the fourth year. Up to now the measurement has not yet started.
- The MSIRI has rarely detected ioxynil in fresh water sample. Ioxynil analysis was replaced by hexazinone. The analysis of 2-4 D has not yet started.
- Heavy metal analysis was conducted on water samples. No sediment and marine fauna samples were analyzed.

**< Evaluation >**

Regular surveys and data accumulation are very important in coastal environment monitoring. The study method and the reliability of acquired data are also indispensable. The target on the number of surveys and the amount of data accumulated was achieved. Some analytical methods were modified and reliability of result was achieved with high reproducibility and reliable calibration line. The analytical technique has been enhanced and the target was achieved.

Measurement of oil hydrocarbon has not yet started. The oil meter is a simple equipment to measure high values of oil hydrocarbon during oil spill. Operation technique for extraction was acquired through the analysis of heavy metals and residual pesticides and the oil meter can be operated when it is necessary. The residual pesticides analysis for 2-4 D has not yet started. It is not recommended to analyse 2-4 D as the MSIRI has not detected it in fresh water samples.

Heavy metals in marine fauna and sediment samples have not yet started. On this point, more effort is expected during the rest of project.

**2-3. Barachois study**

**< Objectives >**

**Collecting physiochemical data in barachois**

**< Activities >**

- The study was conducted in collaboration with aquaculture division and ecology team. Humbert barachois (3 times), Montagu barachois (6 times) and Beau Rivage (7 times) were surveyed as regular sites and 13 other barachois were surveyed once.
- Water and sediment samples were collected from 4 - 6 selected stations at each barachois. Water temperature, salinity, pH, DO, COD, nutrients and ignition loss (on sediment samples) were measured.
- One whole day study was conducted at Beau Rivage barachois on 25 October 1999 at different tides. Water samples were collected four times, namely at mid tide (low to high), high tide, mid tide (high to low) and low tide on spring tide to study the variation of physico-chemical parameters during a day.

**< Achievement >**

- COD was measured to indicate quantity of organic matters in sediment samples at first. However COD was replaced by ignition loss due to the wide variation in COD values and the time-consuming measurement of COD. Ignition loss was measured for 65 sediment samples.
- Regular survey was conducted at Humbert barachois and Montagu barachois. Although the fish culture has not increased no deterioration of water and sediment quality was observed and regular survey was stopped at the two barachois. As from January 1998, Beau Rivage Barachois was monitored as a new regular site as fishes were more actively cultured there and no deterioration of water and sediment quality were observed.

**< Evaluation >**

It is considered that the function of natural purification is higher than the organic load input from fish culture, and optimum density of fish cultured was not reached. The survey was conducted on scheduled frequency and sufficient data was collected. The target was achieved.

**2-4. Data analysis**

**< Objectives >**

**Enhancing the capability of C/P in chemical analysis and data processing**

**< Activity >**

- Macro program has been produced to input data into a sheet for each survey. Results of analysis are calculated and copied into form sheet for report, and the file is separately saved according to the monitoring sites automatically by the program
- The results of study are regularly submitted as monthly report.
- The results of study are compiled and edited annually, and submitted as annual report.
- Study report was presented at AMAS(Annual Meeting of Agricultural Scientist).

**< Achievement >**

- Personal computer was introduced and familiarized for data processing. The capability of data processing was greatly enhanced compared to the beginning of the project.
- Calculation error and input error on the preparation of report were prevented after the macro program was produced, and data can be easily searched.
- Capability of data analysis has been enhanced through preparation of annual report, study report and so on.

**< Evaluation >**

Raw data should be processed accurately, efficiently and saved systematically. It is also important to utilize collected data with proper compilation for report, thesis and so on. In this respect, the target was achieved.

**2-5. Formulation of coastal water quality guideline**

**< Objectives >**

**Formulating the coastal water quality guideline**

**< Activities >**

- Data of water quality standard in many countries was collected, and information of general characteristic and toxicity of chemicals were prepared.

- Draft for the guideline was prepared with counterparts
- Advice was given and necessary documents were prepared.

**< Achievement >**

Coastal water quality guideline was published for public comments on 23 October 1998. The guideline was proclaimed under the Environment Protection Act in April 1999. A copy of the coastal water quality guideline was transmitted to the Seychelles where a request was made to use it as reference.

**< Evaluation >**

The coastal water quality guideline was announced on newspaper and proclaimed under the Environment Protection Act, hence the target was achieved.

**2-6. Manual of coastal environment monitoring**

**< Objectives >**

**Producing manuals for coastal environment monitoring**

**< Activities >**

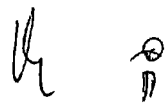
- Draft manual was prepared except on the chapter on data analysis.
- Dr. Satoh short-term expert (Tokyo University of Fisheries) was in Mauritius from 15 March to 7 April 2000 and advised in the preparation of the manual.

**< Achievement >**

The draft of data analysis has not yet been prepared due to time constraint. Part of the draft manual already prepared is being finalised.

**< Evaluation >**

The purpose of this manual is to serve as a guide to continue monitoring activities smoothly after the termination of the project. The manual will also be used by other concerned. The draft already prepared is clear for easy understanding with many figures, pictures and charts. A short-term expert on data analysis will be in Mauritius at the AFRC on September to guide in the preparation of the draft. The draft will be finalised and published.



### 3. Coastal Ecosystem Research

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#### 3-1. Distribution of Marine Organism

##### < Objectives >

Establishment of a database on the distribution of marine organisms in Mauritius.

##### < Activities >

- The specimens and underwater photos were collected during the surveys for understanding the fauna and flora distribution in coastal waters. These data were classified and utilized for the setting up of a database.
- Holothurian (Sea cucumber) surveys were also undertaken at two sites viz. La Preneuse and Baie-du-Cap, in order to assess the abundance and distribution pattern of holothurian in the lagoon of Mauritius.
- Current status of corals and fishes in the Albion lagoon were surveyed by visual census for presentation at the Annual Meeting of Agricultural Scientists (AMAS)

##### < Achievement >

- The establishment of a database on marine organisms was carried out and is ongoing. As at 23<sup>rd</sup> June 2000, data on 330 fishes, 50 corals, 10 holothurians, 37 sponges and 6 seagrass species have already been collected from coastal waters around Mauritius.
- A report on "Holothurian distribution in the lagoon at La Preneuse and Baie du Cap, Mauritius" was prepared and is in print at the Marine Ecology Research Institute, Japan..
- Data on the current status of corals and fishes in the Albion lagoon were incorporated in the paper entitled "Status of the marine environment of the Albion lagoon" presented at AMAS '99.

##### < Evaluation >

- Data on 330 fish species have been collected and this represents two-third of reported fish from Mauritius. Thus the list of the most common fish species in Mauritius has been established. About 50 coral species were identified and most of these corals belonged to the genus *Acropora*. Pichon (1971) reported 36 genera of coral from Mauritius. More effort will be needed to sample and gather information on coral fauna in order to better understand the status of corals in Mauritius. Through such activities, the staff will be in a position to acquire coral taxonomic know-how.

#### 3-2. Ecological Impact Assessment

##### < Objectives >

Conducting long-term monitoring and assessing the coastal ecosystem.

##### < Activities >

- Permanent monitoring stations at 17 sites within 8 locations were set up during the second half of 1998. Data on substrate cover and abundance of commercial fish were collected every 6 months at each permanent station. Additional monitoring were also undertaken at two locations in connection with coastal engineering works and waste water disposal.
- A self-registering thermometer was set at the forereef (-7m) of Albion since October 1998 in order to monitor the sea water temperature in the coral reef area. Data on water temperature were collected every month and graphically represented. However, no recording

Appendix 5

- was done between September 1999 and January 2000 as the thermometer broke down.
- Assessment of coral bleaching was undertaken in 1998 and 1999.
- Coral spawning was observed and recorded in the Albion lagoon in 1998 and 1999. After spawning, observations on coral recruitment and development were undertaken.
- Surveys of seagrass beds started in November 1999 at Albion and Pointe aux Canoniers.
- Several environment impact assessment in connection with coastal development were also undertaken

< Achievement >

- The regular monitoring undertaken is shown below.

Site		Monitoring			
		1	2	3	4
Albion	Back-reef	07-Jul-98	29-Jan-99	29-Jul-99	20-Jan-00
	Fore-reef	07-Jul-98	28-Jan-99	28-Jul-99	18-Jan-00
Pointe aux Sables	Back-reef	08-Oct-98	20-Apr-99	26-Oct-99	15-June-00
	Fore-reef	08-Oct-98	08-Apr-99	23-Sep-99	13-June-00
Trou aux Biches	Back-reef	14-Jul-98	27-Jan-99	03-Aug-99	03-Feb-00
	Fore-reef	14-Jul-98	02-Feb-99	22-Jul-99	11-Jan-00
Anse la Raie	Shore-reef	17-Dec-98	06-May-99	10-Sep-99	25-May-00
	Back-reef	22-Oct-98	27-Apr-99	08-Sep-99	25-Apr-00
Trou d'Eau Douce	Shore-reef	21-Jul-98	13-Apr-99	24-Aug-99	16-Mar-00
	Back-reef	06-Oct-98	30-Mar-99	23-Aug-99	18-Apr-00
Bambous Virieux	Shore-reef	23-Jul-98	08-Feb-99	17-Aug-99	22-Feb-00
	Back-reef	23-Jul-98	18-May-99	02-Sep-99	14-Mar-00
Bel Ombre	Shore-reef	01-Sep-98	04-May-99	21-Oct-99	27-Apr-00
	Back-reef	01-Sep-98	29-Apr-99	15-Sep-99	16-May-00
Ile aux Benitiers	Shore-reef	04-Sep-98	18-Feb-99	10-Aug-99	08-Feb-00
	Back-reef	18-Jun-98	09-Feb-99	12-Aug-99	25-Jan-00
	Fore-reef	04-Sep-98	16-Mar-99	31-Aug-99	10-Feb-00
Baiedu Tombeau	Site 1	-	-	-	04-May-00
	Site 2	-	-	-	11-May-00
Poudre d'Or	Site 1	-	-	-	23-May-00
	Site 2	-	-	-	20-Jun-00

- Report on coral bleaching is under preparation.
- An article on coral spawning entitled "Observation on coral spawning in the lagoon of Mauritius" was published in the "Western Indian Ocean Waters (WINDOW) newsletter (UNESCO 1999).
- A scientific paper on " Present status of seagrass at Albion and Pointe aux Cannoniers" was published in the Proceedings of the Marine Ecology Research Institute, Japan. (April 2000).

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**< Evaluation >**

- The long-term monitoring requires not only experienced divers but also appropriate-sampling designs and logistics for field surveys. This goal has been achieved. A first study on coral recruitment and growth has been completed. However, such study should continue in order to better understand the population process of corals. Based on achievements, this centre will be regarded as one of the focal points in coral reef studies in the Indian ocean region.

**3-3. Barachois study**

**< Objectives >**

Collection of ecological data for effective utilization of Barachois

**< Activities >**

- General survey by underwater observation was undertaken in 6 Barachois.
- Stomach content analyses carnivorous fishes collected were undertaken so as to understand the actual predation effects on commercially important species.
- Quantitative plankton sampling was carried out from February 1999 to February 2000 in order to understand the temporal changes in plankton distribution.

**< Achievement >**

- The report of the status of 6 Barachois was completed.
- The report entitled "Stomach content analyses of carnivorous fishes from various Barachois in Mauritius" was completed.

**< Evaluation >**

Officers acquired basic knowledge and skills for the study. Results of these activities will be published in a scientific journal.

**3-4. Individual research under the framework of the project**

**< Objectives >**

Up-grading the self-study ability of the officers on coastal ecosystem research under the framework of the project.

**< Activities >**

- Officers prepared several reports e.g. coral bleaching, coral spawning, seagrass areas and sea cucumbers.

**< Achievement >**

- 10 scientific articles and 18 internal reports have been prepared.

**< Evaluation >**

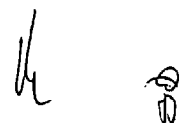
- Preparation of 28 reports and scientific papers was achieved. However, valuable data still remain which need to be published. Capabilities of officers were enhanced.

**3-5. Biostatistics**

**< Objectives >**

Understanding basic biostatistics required for ecological analysis.

**< Activities >**



- Basic analysis methods were studied through lectures and on the job training.
- Writing the textbook by officers.

**< Achievement >**

- A draft of the biostatistics text was prepared.

**< Evaluation >**

- Objective was achieved.

**3-6. Data and Specimen Collection**

**< Objectives >**

Establishing a database on coastal marine organisms (to be used regionally and internationally) in order to understand the present condition of the marine ecosystem.

**< Activities >**

- Input of collected data is ongoing (see 2-1 and 2-2 )
- AFRC-JICA Fish Database (AJFDB) and AFRC-JICA Coral Database (AJCDB) were set up on MS-ACCESS.
- The field guide on coastal fishes is under preparation.
- The setting up of a database on other marine taxa is on going.

**< Achievement >**

- A total of 68 data sets were input and graphically analysed on the AIMS Reef Monitoring Data Entry System (ARMDES). A report on two selected sites in the context of the Indian Ocean Commission project has been presented at the International Tropical Marine Ecosystem Management Symposium (ITMEMS) (1998) and published. The data on the same sites were also reported in the Indian Ocean Commission Project (1999).
- Data on collected species has been input on the database.
- The first draft of the field guide on coastal fishes of Mauritius (including 330 species ) has been completed.

**< Evaluation >**

- The database on marine organisms has been updated and is increasing, especially, fish. More coral sampling is needed for the coral database (Refer para 2-1). The field guide on coastal fishes of Mauritius will be published. However there is need to publish field guides for other categories of marine organisms.

**3-7. Literature**

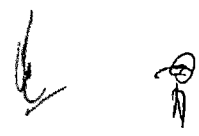
**< Objectives >**

- Understanding the current coastal ecosystem through literature review.
- Exchange of information on a national, regional and international level.
- Public awareness on marine environment.

**< Activities >**

- Collecting related literature.
- Continuing to exchange information with relevant agencies and organizations.
- Holding seminars.
- Publishing and distributing publications.

**< Achievement >**



## Appendix 5

- 5 seminars held .
- 4 posters ( 2 posters on common coral reef fishes,1 on commercial fish and 1 on corals) were published and distributed to schools , colleges, University, NGOs, hotels and international institutions.

### < Evaluation >

- The public awareness campaign and the exchange of information between institutions has been achieved.

