

**Caribbean Regional Fisheries Mechanism (CRFM)**

**Study on the Formulation of  
a Master Plan on the Sustainable Use of  
Fisheries Resource for Coastal Community  
Development in the Caribbean**

**Final Report**

**March 2012**

**Japan International Cooperation Agency (JICA)**

**IC Net Limited**

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## **PREFACE**

In response to requests from thirteen countries which belong to the Caribbean Regional Fisheries Mechanism (CRFM), the Government of Japan decided to conduct a “Study on the Formulation of a Master Plan on the Sustainable Use of Fisheries Resource for Coastal Community Development in the Caribbean” and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Dr. Hiroaki Terashima of IC Net Limited and consists of IC Net Limited between May 2009 and February 2012.

The team held discussions with the officials concerned of CRFM member countries and CRFM, and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of fisheries industry in the Caribbean and to the enhancement of friendly relationship between Japan and the CRFM member countries.

Finally, I wish to express my sincere appreciation to the officials concerned for close cooperation extended to the study.

March 6, 2012

Tsuneo Kurokawa  
Vice-President  
Japan International Cooperation Agency

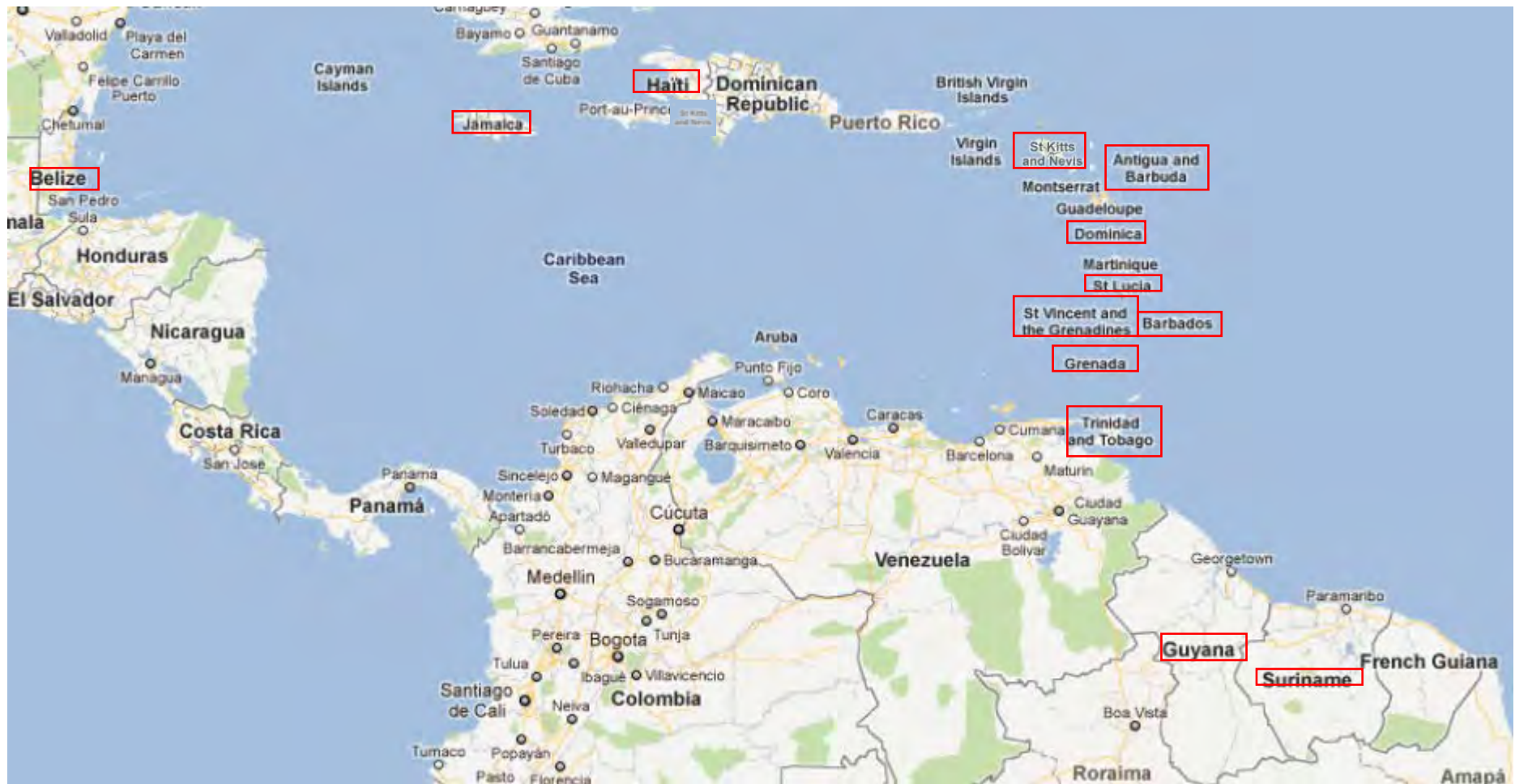


Figure 1 Countries Studied out of the CARICOM member countries

## ABBREVIATIONS

BDC	Biological Data Collection
BFTC	Basic Fishermen Training Course
CARICOM	Caribbean Community
CARIFIS	Caribbean Fisheries Information System
CBRM	Community Based Resource Management
CFP	Caribbean Community Common Fisheries Policy
CFTDI	Caribbean Fisheries Training and Development Institute
CIDA	Canadian International Development Agency
CNFO	Caribbean Network of Fisherfolk Organizations
CPUE	Catch Per Unit Effort
CRFM	Caribbean Regional Fisheries Mechanism
DBS	Diamondback Squid
DO	Dissolved oxygen
DOF	Department of Fisheries
EEZ	Exclusive Economic Zone
EU	European Union
FAD	Fish Aggregating Device
FAO	Food and Agriculture Organization
FCR	Feed Conversion Ratio
FSS	Fisheries Statistical System
GDP	Gross Domestic Product
IDB	Inter-American Development Bank
ID/OS	Institutional Strengthening/ Organizational Strengthening
IMA	Institute of Marine Affairs
JICA	Japan International Cooperation Agency
JOCV	Japan Overseas Cooperation Volunteer
MPA	Marine Protected Area
NACA	Network for Aquaculture Center in Asia-Pacific
NAFCOOP	National Association of Fishers Cooperatives (Dominica)
NFO	St. Lucia Fisherfolk Cooperative Society
OBE	Outboard Engine
PCM	Project Cycle Management
PER	Protein Efficiency Ratio
PDM	Project Design Matrix
RRA	Rapid Rural Appraisal
SVG	St. Vincent and the Grenadines
UWI	University of the West Indies

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# Summary

## 1. Background

The CARICOM member countries, forming continuous island chains in the Caribbean Sea, with the exception of Guyana and Suriname, have narrow and complex exclusive economic zones (EEZ), and share a common interest in the conservation and sustainable management of fisheries resources.

Although many CARICOM member countries are managing their fisheries resources with the assistance of foreign donors under CRFM initiatives, the fisheries resource management system and budget structures are not optimally developed and the fisheries resource management policies are not sufficiently developed. In addition to each national fishery resource management scheme, a joint management scheme for migratory pelagic fish species and other shared resources is required among concerned countries in the region.

In an effort to address these matters, in 2002, the CRFM member countries requested to the Government of Japan two development studies called “Aquaculture Development and the Pelagic Fish” and “Squid Resource Assessment,” and a technical cooperation project called “Establishment of Fisheries Resource Database.” Based on this request, the Government of Japan and the CRFM member countries held a series of discussions and agreed to implement a Study on the Formulation of a Master Plan for Sustainable Use of Fisheries Resources for Coastal Community Development in the Caribbean (hereinafter referred to as the “Study”).

### (1) Purpose of the Study

The Study aims to propose options for a comprehensive resource management approach in the Caribbean region that may include limited entry to coastal fisheries, diversification of the fisheries, and promotion of the optimal use of fisheries resources with cooperation between government and communities. The specific objectives of the Study are as follows:

- 1) Analyze the situation in fishing and rural village, potentials and constraints of development, and needs of community members.
- 2) Identify effective schemes for fisheries resources management and sustainable development, and verify the feasibility of those schemes through the implementation of pilot projects.
- 3) Enhance the policy making and problem analysis abilities of the CRFM Secretariat and fisheries authorities as well as fishers’ organization personnel through various studies and the implementation of pilot projects.
- 4) Formulate a master plan for the sustainable use of fisheries resources in the region that

includes a coastal resource management scheme with cooperation between government and communities, and recommend practical resource management activities.

## **(2) Target Areas**

The Study covers 13 of the 15 CARICOM member countries<sup>1</sup>. The 13 countries are as follows: (1) Antigua and Barbuda; (2) Barbados; (3) Belize; (4) Dominica; (5) Grenada; (6) Haiti, (7) Jamaica; (8) St. Kitts and Nevis; (9) St. Lucia; (10) St. Vincent and the Grenadines; (11) Trinidad and Tobago; (12) Guyana; and (13) Suriname.

## **(3) Scope of the Study**

The Study was implemented in accordance with the Scope of Work signed among respective secretariats of CRFM and CARICOM, and JICA on December 15, 2008. CARICOM Secretariat served as the executing agency for the Study while the CRFM Secretariat was the implementing agency responsible for the technical activities on behalf of the CARICOM member countries.

The scope of the Study includes the following five main components.

- 1) Pelagic resource development and management
- 2) Aquaculture development policy formulation
- 3) Regional fisheries database development
- 4) Support for community-based management (including sedentary resource management)
- 5) Education and training of staff members of fisheries authorities and CRFM Secretariat

As the Study was defined to focus on sustainable resource management of small-scale fisheries, recommendations for industrial fisheries or large scale aquaculture are not addressed in this report.

## **2. Current Situation and Issues of the Region**

Fisheries resources have been declining in the Caribbean region due to degradation or loss of habitat as well as overexploitation of reef and other species. The deterioration of conditions in coastal reef areas and the depletion of fishery resources mentioned above as well as destruction of mangrove forest has directly or indirectly caused severe negative social and economic impacts within the local coastal communities that depend heavily on reef and other areas for their food and livelihood. The maintenance and improvement of coastal habitats such

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<sup>1</sup> The Study directly targets CARICOM member countries, except the Bahamas, an ODA graduate country and Montserrat, an overseas territory of the UK, both of which were not qualified for Japanese ODA.

as reefs and their resources are therefore urgent issues for the sustainable development of local coastal communities. In order to achieve utilization of fisheries resources sustainably in the Caribbean region, the following are critical concerns.

- 1) Insufficient or outdated fisheries resource management and development policies and plans with appropriate management strategies/measures at the national and regional levels.
- 2) Inadequate diversification and/or improvement of economic efficiency of fisheries in order to compensate the reduction of fishers' income due to restriction of fishing activities.
- 3) Weak fisheries statistical system in order to provide essential information to manage and develop fisheries.
- 4) Inadequate development of alternative income sources in order to sustain the livelihood of fishers and coastal communities due to environmental changes and over exploitation of fisheries resources.
- 5) Insufficient marketing activities of fish and processed fish
- 6) Insufficient participation of fishers in resource management activities.
- 7) Weak regional networking strategies/systems.

### 3. Pilot Projects

Pilot projects were designed to improve the situation of resource management focused on the concerns above. The host countries for pilot projects were selected considering the priority list of the member countries, short-listing criteria of pilot projects, and discussion among the member countries.

The pilot projects implemented are as follows:

<b>Pilot Project</b>	<b>Host Country</b>
Coastal fisheries resources management (incl. Pelagic and Demersal species) Pilot Project	St. Lucia, Dominica
Aquaculture Pilot Project	Jamaica, Belize
Fisheries Statistics Pilot Project	St. Vincent and the Grenadines, Guyana

Lessons learned from the implementation of the pilot projects are as follows.

#### 1) **Formulation of resource management policies, plans, and measures**

FAD fishery management plan is being prepared with participation of fishers and fisheries authority. Fishers' own initiatives and participation ensures the practicality of the formulation of resource management policies, plans and measures. Both the Technical and financial support of



FAD fishery stimulated the formulation process.

## **2) Diversification and improvement of the efficiency in fishing activities**

Diversification of fisheries with precautionary utilization of non or under-utilized fishes along with the collaboration of fishers proved workable. Appropriate technical assistance based on communication between fishers and fisheries authorities was essential, with economic benefits crucial for fishers to participate in new fishing activities.

## **3) Marketing**

Marketing for a new species was undertaken. Regarding diamond back squid (DBS) fishery, a group of fishers and a fishery authority was formed to promote the sale of DBS. DBS processing workshop and tasting event inviting chefs from restaurants showed a potential market for tourism.

## **4) Improvement of fisheries resource information**

The Participation of fishers in statistical data collection was found essential. Participatory resource management starts with an understanding of the resource situation by fishers themselves. Communication between fishers and fisheries authorities needs to be strengthened through regular meetings, as well as providing feedback to the information given by fishers.

## **5) Development of alternative income sources**

Small-scale aquaculture shows potential as an alternative income source for small-scale fishers. Participation of a group of fishers in aquaculture reduces fishing pressure on lobster and conch fishery.

## **6) Participatory resource management**

As noticed from the above experience, the participatory approach is at the core of resource management in data collection, formulation of management plan, reduction of fishing pressure through diversification of fishing activities, and development of alternative income sources.

## **7) Regional networks**

Sharing information and technologies has proved to be much needed among member countries. The creation or enhancement of regional networks is essential.

## **4. Strategies**

The following vision and goals were determined after carefully assessing current statuses, pilot projects, and analyses regarding fisheries resources.

**Vision:** Coastal communities in the Caribbean region will have a better quality of life with a

higher standard of living while becoming more resilient to external changes in the climate and natural environment.

**Long-Term Goal:** Co-management of fisheries resources becomes common in the region in ten years with 80% of the member countries exercise this principle.

**Medium-Term Goal:** Co-management models are adapted in several countries with the use of regional working groups and other stakeholders such as national working groups and fishers' organizations. Within five years, the management capacity of the CRFM including its Council, Forum, Secretariat, working groups, and national fisheries authorities is enhanced and CRFM's governance is improved.

**Short-Term Goal:** Practical co-management models for sustainable use and management of fisheries resources are established through community-based projects for fisheries management in selected countries in three years. Legal and regulatory instruments for supporting the co-management are also formally established. Information regarding practical co-management models with legal and regulatory instruments is shared with other member countries.

In order to achieve the vision and goals, two guiding principles and four approaches were proposed to overcome the issues in the CARICOM member countries.

**Guiding principles within fisheries resource management:**

- 1) Promotion of Participatory Resource Management and Development toward Co-management
- 2) Formation and Strengthening of Regional Network

**Approaches:**

- 1) Formulation of Resource Management Policies, Plans, and Measures
- 2) Diversification and Improvement of Economic Efficiency of Fisheries
- 3) Improvement of Fisheries Information
- 4) Development of Alternative Income Sources

**5. Plan for the Sustainable Use of Fisheries Resources for Coastal Community Development**

One of the guiding principles, participatory resource management, was found essential for sustainable resource use, data collection, and even aquaculture development. Participatory resource management principle is thus undertaken and explained in respective approaches.

The other guiding principle regarding functional regional networks was developed into a

framework for regional cooperation based on CRFM working groups' activities.

The four approaches were further refined, and detailed activities were introduced in accordance with the characteristics of each approach. Accordingly, plans for regional network, artisanal fisheries resource management and development, improvement of fisheries information, and development of alternative income sources are presented in the chapter 5.

## **6. Conclusions and Recommendations**

### **(1) Conclusions**

Following lessons were learned from the pilot projects.

- 1) Sharing experiences and information stimulated the activities in both countries and increased efficiency of the pilot projects.
- 2) In order to encourage participation of fishers, it is essential that provision of technical guidance and/or financial incentives.
- 3) Pilot projects provided an opportunity for fisheries authorities and fishers to work together toward co-management of fisheries resources.
- 4) Participation of fishers in statistical data collection was found essential. Communication between fishers and fisheries authorities needs to be strengthened through regular meetings and feedback of the information given by fishers.
- 5) Low-cost small-scale aquaculture showed potential as an alternative income source for small-scale fishers.
- 6) Intermediate culture would be a good option to increase the number of aquaculture farms. It will reduce the responsibility of fingerling production and enable the increase of seed production by the fisheries authority.
- 7) Various manuals and technical reports were produced during the implementation of the pilot projects. Staff members of fisheries authorities as well as the CRFM Secretariat enhanced their knowledge and skills through those tasks.

Other lessons learned were;

- 8) Fisheries resource management not only encompasses fishing regulations but also the economic benefit to fishers and their communities. It emphasized the importance of a comprehensive approach that includes diversification and economic efficiency in fishing, the development of alternative incomes, and the collection of fisheries information that is vital for fundamental resource management and development.

- 9) Regarding the implementation structure, the establishment of five service programs within CRFM was proposed to address technical issues of member countries. Each service program was composed of a working group with members from various countries and regional specialty institutes for exchanging information and enhancing the fisheries resource management ability of the member countries as well as the region.

## **(2) Recommendations**

- 1) Since both small-scale and industrial fisheries target the same fish species, the influence of industrial fisheries in resource management cannot be ignored. It is necessary to conduct by-catch surveys with collaboration of industrial fisheries.
- 2) Since the study concentrated in the fisheries sector, tourism and other sectors were not included in the master plan. It is recommended to investigate tourism and other sectors' activities as alternative income source for small-scale fishers.
- 3) Considering the food security as well as ecological nature of fish products, the target of the aquaculture development in the report is to increase fish supply to each country's own market through promotion of small-scale aquaculture at this time. However, some countries have a preferable environment as well as economic and geographical advantages to pursue an export market for aquaculture products. A careful marketing survey and technical investigation are required before implementation so that ecologically, socially and financially sustainable aquaculture is realized.
- 4) A proposed regional network based on the five service programs and their working groups will lead the bottom-up strategy. With the strengthened regional network, CRFM will be a more effective and responsive organization for the member countries' genuine needs and initiatives.
- 5) A constant effort is required to keep the resources at an optimal level. It is recommended to accumulate successful cases through actions and producing tangible outputs that will be a driving force to improve resource conditions and achieve sustainable use of those resources.

# **1. Introduction**

## **1.1. Background**

The fisheries sector is one of the most dynamic and important production and economic sectors in the world. Fisheries and aquaculture directly and indirectly play an essential role in the livelihoods of millions of people around the world. According to FAO, in 2009 the total number of commercial fishers is estimated as 38 million. Fishery industries provide direct and indirect employment to over 500 million people in the world.

Among the Caribbean countries, fisheries contribute to the food security and the economic, social, and cultural aspects of the societies. This sector provides employment and livelihood opportunities for some of the most socio-economically disadvantaged people within Caribbean societies. It also contributes to economic stability, especially in coastal communities throughout the Caribbean, and to foreign exchange earnings. Approximately 182,000 people are directly and indirectly employed in the sector. The contribution of fisheries to GDP in Caribbean Regional Fisheries Mechanism (CRFM) member countries varies from 0.13% in Trinidad and Tobago to 6.85% in Guyana. The total annual production in the region is estimated at 200,000 metric ton (MT) and the national production varies from 1,000 MT in the Turks and Caicos Islands to more than 50,000 MT in Guyana. The estimated annual value of production is between US\$500 million to US\$600 million. Fish contributes about 9.9% of the total share of dietary protein in the region. This varies from 6% in Trinidad and Tobago to 16% in Grenada. Notwithstanding the high cost of fish and fish products compared with other forms of animal protein, Caribbean people show a preference for fish. Few other sectors contribute to human and economic welfare as much as fisheries from a regional perspective.

In addition, the sector is making significant contributions to meeting the expectations of the United Nations Millennium Development Goals to end poverty by 2015.

The sector is one of the more productive ones within the Caribbean economies, directly contributes to achieving most of the eight Millennium Development Goals which highlight its importance at the national, regional and international levels.

The Caribbean Community (CARICOM) established CRFM in March 2003 as an

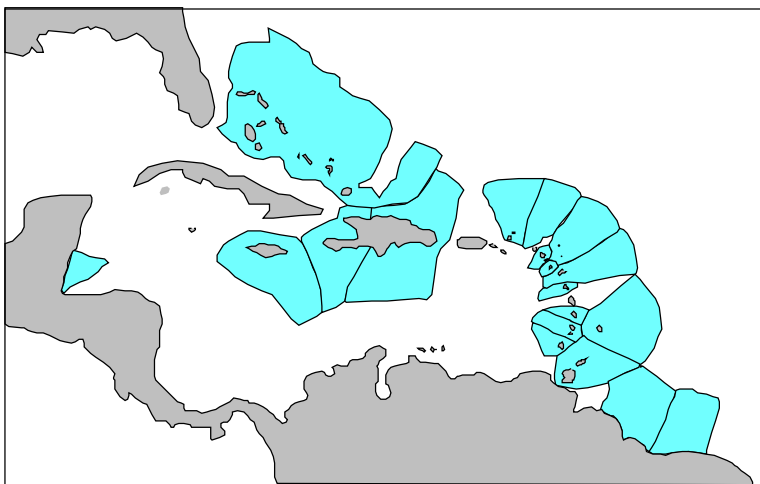


Figure 1-1: Schematic diagram of EEZ of CARICOM Member Countries

organization to promote and facilitate the responsible utilization of the region's fisheries and other aquatic resources for the economic and social benefits of the current and future population of the region. It encourages cooperation among the member countries for sustainable use of fisheries resources in the region.

The CARICOM member countries, forming continuous island chains in the Caribbean Sea, with the exception of Guyana and Suriname, have narrow and complex exclusive economic zones (EEZ), and share a common interest in the conservation and sustainable management of fisheries resources (Figure 1-1)<sup>2</sup>.

Although many CARICOM member countries manage their fisheries resources with the assistance of foreign donors under CRFM initiatives, neither the fisheries resource management system and budget structures nor the fisheries resource management policies are sufficiently developed. In addition to each national fishery resource management scheme, a joint management scheme for migratory pelagic fish species and other shared resources is required among concerned countries in the region.

Under these circumstances, CRFM in 2002 requested to the Government of Japan two development studies: the Aquaculture Development and the Pelagic Fish and Squid Resource Assessment, and another technical cooperation project called the Establishment of Fisheries Resource Database. In response, the Government of Japan dispatched a project formulation team in September 2003 to evaluate and analyze the state of affairs as well as issues within the fisheries sector of the Caribbean region. Based on the results, the team recommended conducting a development study to determine the needs, relevance, and effectiveness of these two development projects. As a result, CRFM requested the Government of Japan to implement a Study on the Formulation of a Master Plan for Sustainable Use of Fisheries Resources for Coastal Community Development in the Caribbean (hereinafter referred to as the "Study").

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<sup>2</sup> The boundaries of EEZ shown in the Figure 1-1 are hypothetical boundaries for illustrative purpose only to highlight the overlapping and complex mosaic of maritime jurisdictions in the semi enclosed Caribbean Sea and shall not be interpreted as implying or expressing an opinion on the location or demarcation of the maritime boundaries of any State or group of States.

The purpose, scope, target areas and implementation strategy of the Study are as shown below.

## **1.2. Purpose and Scope of the Study**

### **1.2.1. Purpose**

The Study aims to propose options for a comprehensive resource management approach in the Caribbean region. The specific objectives of the Study are as follows:

- 1) Analyze the situation in fishing and rural villages, potentials and constraints of development, and needs of community members.
- 2) Identify effective schemes for fisheries resources management and sustainable development, and verify the feasibility of those schemes through the implementation of pilot projects.
- 3) Enhance the policy making and problem analysis abilities of the CRFM Secretariat and fisheries authorities as well as fishers' organization personnel through various studies and the implementation of pilot studies.
- 4) Formulate a master plan for the sustainable use of fisheries resources in the region that includes a coastal resource management scheme with cooperation between government and communities, and recommend practical resource management activities.

### **1.2.2. Scope**

The Study was implemented in accordance with the Scope of Work signed among the respective secretariats of CRFM and CARICOM, and JICA on December 15, 2008. The CARICOM secretariat served as the executing agency for the Study while the CRFM Secretariat was the implementing agency responsible for the technical activities on behalf of the CARICOM member countries.

The Scope of the Study includes the following five main components.

- 1) Pelagic fisheries development and management component
- 2) Aquaculture development component
- 3) Participatory approaches to management (including sedentary resources management)
- 4) Regional database component
- 5) Education and training component

As the Study focuses on sustainable resource management of small-scale fisheries, recommendations for industrial fisheries or large-scale aquaculture are not addressed in this report.

### **1.2.3. Target Areas**

The Study covers 13 of the 15 CARICOM member countries<sup>3</sup>. The 13 countries are as follows: (1) Antigua and Barbuda; (2) Barbados; (3) Belize; (4) Dominica; (5) Grenada; (6) Haiti, (7) Jamaica; (8) St. Kitts and Nevis; (9) St. Lucia; (10) St. Vincent and the Grenadines; (11) Trinidad and Tobago; (12) Guyana; and (13) Suriname.

On the whole, the Study targets these countries' EEZ and inland waters. Due to the huge coverage area, however, local surveys were conducted within limited places that represent different characteristics of the geography and fisheries.

### **1.3. Methodology and Implementation Schedule**

As it was a spearhead case for Japanese ODA in conjunction with a regional organization to conduct a multi-national development study with many stakeholders, the Study was carefully preceded with transparency. During the inception mission, all countries were visited reviewing both the purpose and the contents of the Study. Steering committee meetings with participation from a majority of the CARICOM countries and JICA staff were held every year to report the progress of the Study. Numerous days were spent during the selection of pilot projects. When the candidate countries were decided, MOUs were signed among the stakeholders to clarify the responsibilities of each party and an agreement was made to share the technology and the knowledge developed during the implementation of the pilot projects with other member countries. These surveys as well as the pilot projects were conducted with the CRFM Secretariat, the study team and the host countries cooperating closely. Thus, the Study was conducted carefully, facilitating the member countries toward better understanding and appreciation of the Study activities.

The Study commenced in March 2009 and the inception mission was done in May 2009. Following the inception mission, baseline surveys were conducted in two parts: a general country survey with sector analysis and a detailed community baseline survey. Based on the country reports, regional reviews were prepared for the five main components of the proposed Master Plan. A draft Preliminary Master Plan was prepared and discussed in the first steering committee in December 2009 to analyze the results of the surveys. The concepts of the pilot projects were discussed in the steering committee.

The second year's activity started in February 2010. The Draft Preliminary Master Plan was completed with further comments from the CRFM Secretariat and JICA. Meanwhile, the candidate countries for pilot projects were selected.

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<sup>3</sup> The Study directly targets CARICOM member countries, except the Bahamas, an ODA graduate country and Montserrat, an overseas territory of the UK, both of which were not qualified for Japanese ODA.



The third year's activity started in January 2011. The implementation and monitoring of the pilot projects continued until October 2011, and the second Progress Report and the second Field Report were submitted in May and September 2011 respectively. These reports covered the implementation of the pilot projects.

Below are the details of these activities.

(1) Inception mission: May-June 2009

The Japanese Study team organized by IC Net, the Japanese consulting firm entrusted to implement the Study by JICA, started the mission by introducing and explaining the Inception Report to the CRFM Secretariat. The Study team members met with the chief fisheries officers, core staff of the fisheries departments or divisions to explain the purpose and procedure of the Study and requested cooperation for the forthcoming baseline survey. The general situation of the fisheries sector in each target country was assessed during the mission.

(2) Baseline survey 1 (General Survey): July-November 2009

Hamilton and Associates, a regional consulting firm was chosen through a competitive tender, formed a team consisting of four specialists to conduct secondary data analysis and in-country surveys with questionnaires and interviews. The survey results are described in the 13 country reports and four sub-sector reports.

(3) Baseline survey 2 (Detailed Survey): July-November 2009

The second part of the baseline survey was designed to collect more detailed information through visits to fishing villages in each target country. The Study team members consisting of the Japanese team together with CRFM Secretariat staff, conducted target group interviews and Rapid Rural Appraisal (RRA) workshops to understand the circumstances of current fishing operations, resource usage, and the communities' needs. During these activities, a calendar of the fishing season, a map of the fishing ground, and other outputs were produced.

The team also conducted both Project Cycle Management (PCM) and Institutional Development/Organizational Strengthening (ID/OS) workshops to assess the abilities of fisheries department/divisions. As a result, problems were identified with both internal and external factor analysis, and analytical charts were produced. Candidates for pilot projects (long list) were also organized with the results of these workshops taken into account.

(4) Formulation of Draft Preliminary Master Plan: February-March 2010

The Preliminary Master Plan was revised taking into consideration the comments from the participating countries, CRFM Secretariat, and JICA. The revised Preliminary Master Plan was distributed to the CRFM member countries during the CRFM Forum meeting in April 2010.

(5) Preparation for the pilot project: March-May 2010

Three components of the pilot projects were agreed upon and six countries were selected to implement the pilot projects as follows. Although the pilot projects were implemented in a

limited number of countries, the knowledge and lessons learned shall be shared with all member countries by conducting workshops and disseminating reports to all the countries and key stakeholders.

The pilot projects were decided to be implemented at the host country's initiative and all countries involved agreed on the implementation process and responsibilities, including hosting regional workshops for some countries.

<b>Pilot Project</b>	<b>Host Country</b>
Coastal Fisheries Resources Management (incl. Pelagic and Demersal species) Pilot Project	St. Lucia, Dominica
Aquaculture Pilot Project	Jamaica, Belize
Fisheries Statistics Pilot Project	St. Vincent and the Grenadines, Guyana

(6) Preparation of Field Report: June 2010

The draft Field Report (FR) was submitted to JICA and CRFM in June 2010. The FR included an outline of the survey activities and outputs for the commencement of the Study up to the end of May 2010. The FR also included the abstracts of country reports from the 13 target countries as an output of the baseline survey, and the results of ID/OS and PCM workshops conducted during the detailed surveys.

The FR was finalized based on the comments from the CRFM Secretariat and JICA and distributed during the steering committee meeting in early November 2010.

(7) Preparation of Progress Report: October-November 2010

The draft Progress Report (PR) was submitted to JICA and CRFM in the beginning of November 2010.

The PR described the progress of the pilot projects which were being implemented in six countries.

The PR was finalized based on comments from the CRFM Secretariat and JICA and distributed during the steering committee meeting in early November 2010.

(8) Second Steering Committee Meeting

The second steering committee meeting was held in St. Vincent and the Grenadines on December 6 and 7, 2010. Representatives from nine member countries, two JICA experts from the region, seven staff members of CRFM secretariat and four members of the Study team participated in the meeting. During the meeting, the progress of the six pilot projects was reported and discussed. There was also a session to discuss the preparation of the master plan and future activities.

(9) Preparation of Interim Report: November-December 2010

The draft Interim Report (IR) was submitted to CRFM and JICA. It included updated information on the implementation of pilot projects, and covered guiding principles based on which the Master Plan was to be formulated. This draft IR was discussed in the second steering committee meeting held in December 2010. After incorporating feedback from the CRFM Secretariat, participating countries and JICA, the IR was finalized.

(10) Preparation of Progress Report 2: April-May 2011

The draft Progress Report 2 (PR2) was submitted to JICA and CRFM and was finalized taking their comments into consideration. This Report included detailed information on the progress of pilot projects.

(11) Preparation of Field Report 2: September 2011

The draft Field Report 2 (FR2) was submitted to JICA and CRFM and was finalized taking their comments into consideration. It included progress on each pilot project, results, lessons learned and recommendations.

(12) Third Steering Committee Meeting: to be held in January 2012

The third steering committee meeting and the final one is to be held in January 2012 as a "Dissemination Workshop" in St. Lucia. The Draft Final Report (DFR) will be distributed to the participants in advance and will be discussed during the meeting. The meeting will also provide an opportunity for dissemination and a chance to share the achievements and lessons learned from the pilot projects among the CRFM member countries.

(13) Preparation of the Final Report: January-March 2012

Based on feedback obtained from the CRFM member countries and JICA, the Draft Final Report (DFR) will be revised. This amended DFR was distributed once again among the CRFM member countries and JICA for their confirmation before finalization.

## **2. Current Situation and Issues of the Region**

### **2.1. Current Situations and Issues within the CARICOM Member Countries**

General information regarding capture fisheries and aquaculture in all the target member countries was collected. All the outputs from workshops and interview sessions attended by staff members of the fishery authorities as well as local fishers in the target member countries were analyzed and later compiled into country reports. The following is an abstract of each member country. Further information regarding each country is presented in the “Country Reports” printed separately. Tables 2-1 and 2-2 show fishery resources utilized by local small-scale fishers.

#### **2.1.1. Country Summary**

##### **(1) Antigua and Barbuda**

In Antigua and Barbuda, local fishers mainly catch queen conch and Caribbean spiny lobsters with fish-pot, by diving, or with the use of gill-nets inside the reef as well as on the reef slope. They also catch small pelagic species such as jacks and scads in shallow coastal waters by seine net. Local fishers also benefit from the high price of fish due to demands of the tourism industry. Aquaculture development is very limited.

##### **(2) Barbados**

In Barbados, the dolphinfish and flying fish are the most important commercial species. During their off season, local fishers catch reef fish in coastal reefs and the reef slope. The stock of both the queen conch and the Caribbean spiny lobster is limited. The Sea urchin is fully utilized and seems to be overexploited. They also catch small pelagic species such as jacks and scads in shallow coastal waters with a seine net. Resource management regulations seem ineffective due to the fishers’ lack of awareness of them and inadequate law enforcement. The fish price is low. There is no commercial aquaculture.

##### **(3) Belize**

In Belize, many fishers conduct fishing activities inside the reefs and on the reef slope. The Caribbean spiny lobster and the queen conch are the most important species for small-scale fishery. These local fishers also catch reef fish such as snapper, grouper, grunts and sea-bream by hook and line, gill-nets, spear fishing, and use fish-pots around the reef. An increased number of fishers have also caused a decline in the Caribbean Spiny lobster and queen conch catch per fisher. Industrial aquaculture (shrimp, tilapia, and cobia) is in place in Belize but may be unsustainable. The development of alternative income sources is needed, such as in small-scale aquaculture and offshore pelagic fisheries. Support for small scale aquaculture technology and financing should be considered.

##### **(4) Dominica**

In Dominica, the coastal reef is not well-developed and the surrounding shelf area is

narrow with steep slopes leading to deeper waters. Local fishers catch reef fish such as snapper and grouper by hook and lines as well as with fish-pots on this off-shore slope. In the limited shallow area, fishers also collect the Caribbean spiny lobster and the queen conch by diving or with fish-pots. FAD fishing was introduced in the late 1990s and many fishers shifted from inshore fishery activities to offshore pelagic fishing. However, since there are conflicts over FADs deployed near the shore, the fishers tend to deploy FADs further away to avoid conflict. Due to the short life spans of FAD, the fishers must shoulder increases in the cost of fishing. Fisher organizations are not fully functional (25% of the fishers are not members). Both local tilapia and freshwater shrimp aquaculture exist but on a very limited scale.

#### **(5) Grenada**

In Grenada, the situation is similar to Dominica in the coastal reef and surrounding shelf area fisheries. Pelagic fishery activities have been popular since the 1940s and tuna long line fishing has been successful since its introduction in 1991. However, there are still issues to resolve such as in organizing fisheries cooperative. Fresh water aquaculture has not been successful. Small scale sea moss culture is being practiced, with the products used as a material in a local drink.

#### **(6) Guyana**

Along the coast of Guyana, brackish waters containing rich nutrition from the Orinoco and the Amazon rivers extend over a large area and the coastal reef is not well-developed. The coastal (continental shelf) fishery has been developed utilizing croaker (drum fish) and sea-catfish inhabiting the muddy bottom. Fisheries data collection and management is inadequate and little is known about the present resource status, although fishers claim that catches have been declining. Extensive brackish water shrimp culture and large scale freshwater culture exists, but there is limited small-scale farming. It is necessary to develop low cost local feed for the development of small-scale aquaculture.

#### **(7) Suriname**

In Suriname, the fishing environment is the same as in Guyana and the situation of fisheries statistical data collection is similar. Fishing costs have also gone up due to increases in fuel price in both countries. Therefore, a general need to develop alternative means of income for fishing communities is considered to be high with small-scale aquaculture exhibiting an initial potential for this purpose. Extensive brackish water shrimp culture and large scale freshwater culture have been developed, but there is limited small-scale farming. It would be vital to develop low cost feed for the development of small-scale aquaculture e.g. tilapia, and its market.

#### **(8) Haiti**

In Haiti, coastal reef fisheries have been very active although most of the small-scale fishing boats are not powered. Large-scale deforestation, poor land management, and unregulated coastal developments have resulted in extensive coastal erosion and sedimentation into coastal waters and devastating damage to coastal fisheries. In addition, there are no

fisheries management measures. Therefore, an integrated coastal management zone is needed. There has been some assistance with aquaculture development.

#### **(9) Jamaica**

In Jamaica, many fishers implement fishing activities inside the reef, the reef flats, and along the reef slope. The Caribbean spiny lobster and the queen conch primarily caught by diving and with the use of fish-pots are very popular. The local fishers also catch reef fish such as snapper, grouper, grunt, and sea-bream with hook and lines, gill-nets, spear fishing, and fish-pots around the reef. The decline of fishery resources is attributed mainly to destruction of habitat by economic developments and illegal fishing activities. Fishery cooperatives are not fully functional and community based fisheries resource management efforts have not been effective as yet. Tilapia aquaculture has been developed at the industrial level, while planned small scale aquaculture development has been affected by inadequate extension services.

#### **(10) St. Kitts and Nevis**

In St. Kitts and Nevis, most fisheries are small-scale. 75% of fishers are engaged in reef fishing. 40% of the catch is from coastal pelagic fish. Local fishers have started to deploy FADs and FAD fishing techniques need to be improved. There is a very limited amount of tilapia and shrimp aquaculture activity.

#### **(11) St. Lucia**

In St. Lucia, the island shelf is limited and the fish catch is mostly migratory pelagic species (70% of total catch) due to the depletion of near shore resources. In order to improve the economic efficiency of pelagic fishery, FAD was recently introduced. Fishers' expectation for this development is high. Tilapia and fresh water prawn hatcheries were set up with the assistance of Taiwan, but aquaculture development is limited at present. Either fish pot or bottom long line fishing activities are undertaken during August and October as it is the off season of troll fishery.

#### **(12) St. Vincent and the Grenadines**

In St. Vincent and the Grenadines, the composition of fish catch is as follows: offshore pelagic (35%); inshore pelagic (45%); demersal fish (10%); lobster and conch (5%); and others 5%. Demersal fish are being depleted, especially in the Bequia island area. Fishing effort within the demersal fishery should be reduced, since it is currently experiencing heavy exploitation pressure. FAD fishing has not yet become common. Fishers cannot go off shore due to their small boat size. Both tilapia and fresh water shrimp aquaculture has been attempted and it has been suggested that commercial operations would be very difficult.

#### **(13) Trinidad and Tobago**

In Trinidad and Tobago, Trinidad is generally not active in reef fishing whereas Tobago is active with the Caribbean spiny lobster and queen conch during the tourist season. Industrial development in Trinidad has led to the degradation of fish habitats. The development of

under-utilized resources and alternative income sources is needed. In Tobago, shallow water FAD fishing has been introduced, but the Tobago market is too small for the catch. Tilapia, armored cat fish, and shrimp aquaculture are being developed in Trinidad.

**Table 2-1: Fisheries Resources Utilized by Small-scale Fishery in Each Member Country (1)**

Country	Target fish Demersal fish on the continental shelf	Reef fish, conch and lobsters	Other shallow water reef species	Deep slope fish	Small coastal pelagic fish	Medium and Large pelagic fish	Non-utilized offshore resources
Antigua and Barbuda	X	+++ Lobster and Conch	+	+ Snapper, Grouper	++ Jack, Scad, Bonefish, Flying Fish (offshore)	+ Tunas, Dolphinfinh, Wahoo, Billfish (mainly for Sports fishing)	+ Diamond back squid
Barbados	X	+++ Parrotfish, Surgeonfish, (Lobster and conch are not highly developed)	++ Sea urchin (fully utilized and overfished)	++ Snapper, Grouper	+++ Flying Fish, Jack, Herring, (These fish are caught by smaller day boats)	+++ Dolphinfinh, Wahoo, Billfish, Shark (These fish are caught by larger ice boats)	+ Diamond back squid
Belize	X	+++ Conch and Lobster (fully developed and well managed)	+ Sea cucumber	+	++ Jack	x Wahoo, King mackerel, Black-fin tuna (Those fish are caught by sports fishing vessels)	+
Dominica	X	++ Triggerfish, Goatfish, Parrot fish, (Lobster and conch have declined)	+	+++ Snapper and Grouper (heavily exploited by French territory fishers)	++ Sardine, Robin, Scad, Flying Fish	+++ Wahoo, Dolphinfinh, Black-fin tuna, King Mackerel	+ Diamond back squid
Grenada	X	++ Lobster (fully exploited by scuba fishing)	+	+++ Snapper and Grouper	++ Scad, Robin and Jack (caught for food and bait fish), Flying Fish	+++ Wahoo, Dolphinfinh, King mackerel, Black-fin tuna (caught by trolling and longline since 1991)	+ Diamond back squid
Guyana	+++ Gray Snapper, Sea Trout, Cat fish, Snook, Bangamary	X	+	+ Snapper (caught by industrial fisheries using traps)	++ Jack, Robin, Sardine	x Wahoo, Black-fin tuna (These fish are caught as bi-catch of gill net)	+
Haiti	X	++ Lobster and conch (these fish are fully exploited, but there is no management)	+	+	++	+ Wahoo, Dolphinfinh, Black-fin tuna (accidentally caught by hand lines), King mackerel (caught in coastal areas by gill nets)	+

+++ : Commercialized and common, ++ : Commercialized, + : Resource may exist but is not common, x : Resource does not exist or is not accessible to small-scale fishers



: Fisheries regulation exist

**Table 2-2: Fisheries Resources Utilized by Small-scale Fishery in Each Member Country (2)**

Country \ Target fish	Demersal fish on continental shelf	Reef fish, conch and lobsters	Other shallow water reef species	Deep slope fish	Small coastal pelagic fish	Medium and Large pelagic fish	Non-utilized offshore resources
Jamaica	X	+++ Parrot fish, Surgeonfish, Lobster and Conch (Lobster and Conch are overfished)	+	++ Snapper, Grouper	++ Herring, Sprat, Jack	x Dolphinfish, King mackerel, Black-fin tuna (occasionally collected but unpopular due to seasonality and low abundance)	++ Diamond back squid
St. Kitts and Nevis	X	+++ Conch, Lobster, Grouper, Hind, Grunt, Surgeonfish, Trigger fish, Snapper, goat fish (Conch and Lobster fishing are fully developed and well managed)	+	++ Snapper, Grouper	+++ Garfish, Ballyhoo, Jack, Herring	++ Dolphinfish, shark (caught by trolling)	+ Diamond back squid
St. Lucia	X	++ (Conch and lobster are minor fishery resources but are nearly overfished due to the demand from hotels)	+	++ Snapper, Grouper	+ Flying Fish, Jack, Ballyhoo. (Sardine are important for west coast fishers)	+++ Dolphinfish, Wahoo, Tuna spp.	+ Diamond back squid
St. Vincent and the Grenadine	X	+++ Rock hind, Snapper, Red Hind, Conch and Lobsters	+ Sea cucumber, Sea urchin, Octopus	++ Snapper, Grouper	+++ Jack, Robin, Ballyhoo	+++ Black-fin tuna, Dolphinfish, King fish, Bill fish	+ Diamond back squid, Flying Fish, Shark, Ray
Suriname	+++ Large demersal fish, Shrimp (The shrimp catch exceeded its MSY in recent years.)	X	+	+	x Bi-catch of trawlers and discarded fish	X	+
Trinidad and Tobago	+++	++ (The conch fishery is minor and is conducted only in Tobago)	+	+	++ Flying Fish, Sardine, Scad, Herring, Robin	+++ Wahoo, Dolphinfish, King mackerel.	+ Diamond back squid

+++ : Commercialized and common, ++ : Commercialized but not common, + : Resource may exist but is not utilized, x : Resource does not exist or is not accessible for small-scale fishers

: Fisheries regulation exist

### **2.1.2. Current Situation of Regional Cooperation in the Caribbean**

There are a number of regional technical cooperation projects going on and it is possible to implement these projects based on the Regional Resource Management Policy. CRFM has been coordinating the complex relationship of regional organizations and donor communities.

#### **2.1.2.1. Role and Structure of CRFM**

The CRFM was established in 2003 as a result of the CARICOM Fisheries Resource Assessment and Management Program, a Canadian technical cooperation project from 1991 to 2001. CRFM strives to achieve its goal through cooperation among the member countries for the benefit of the people of the Caribbean region<sup>4</sup>. The specific objectives of CRFM are as follows:

- Efficient management and sustainable development of marine and other aquatic resources within the jurisdiction of its member countries;
- Promotion and establishment of co-operative arrangements among interested member countries for efficient management of shared, straddling, or highly migratory marine and other aquatic resources;
- Provision of technical advisory and consultative services to fisheries divisions of the member countries in order to assist with the development, management and conservation of their marine and other aquatic resources.

It is made up of the following organs:

- **The Ministerial Council** is an oversight body that has responsibility for (*inter alia*), policies, program appraisal, resource allocation, fisheries cooperative agreements, and related decision-making.
- **The Caribbean Fisheries Forum** transfers technical leadership to CRFM and technical advice to the Ministerial Council, reviews and recommends work programs to the CRFM; and oversees the operations of the Technical Unit.
- **The CRFM Secretariat/Technical Unit** is responsible for implementation and coordination of the work programs, coordinates with national fisheries authorities, mobilizes resources, and manages the institutional networks to promote the CRFM's optimal involvement and efficient functioning<sup>5</sup>.

#### **2.1.2.2. Caribbean Regional Common Fisheries Policy (CFP)**

The CFP is a comprehensive guide for the member countries' national small-scale and industrial fisheries as well as aquaculture development and management in the region. It was recently approved by the CRFM Ministerial Council.

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<sup>4</sup> Source: *CRFM Second Medium-Term Plan 2008-2011*, (CRFM), 2008, 10

<sup>5</sup> Ibid.

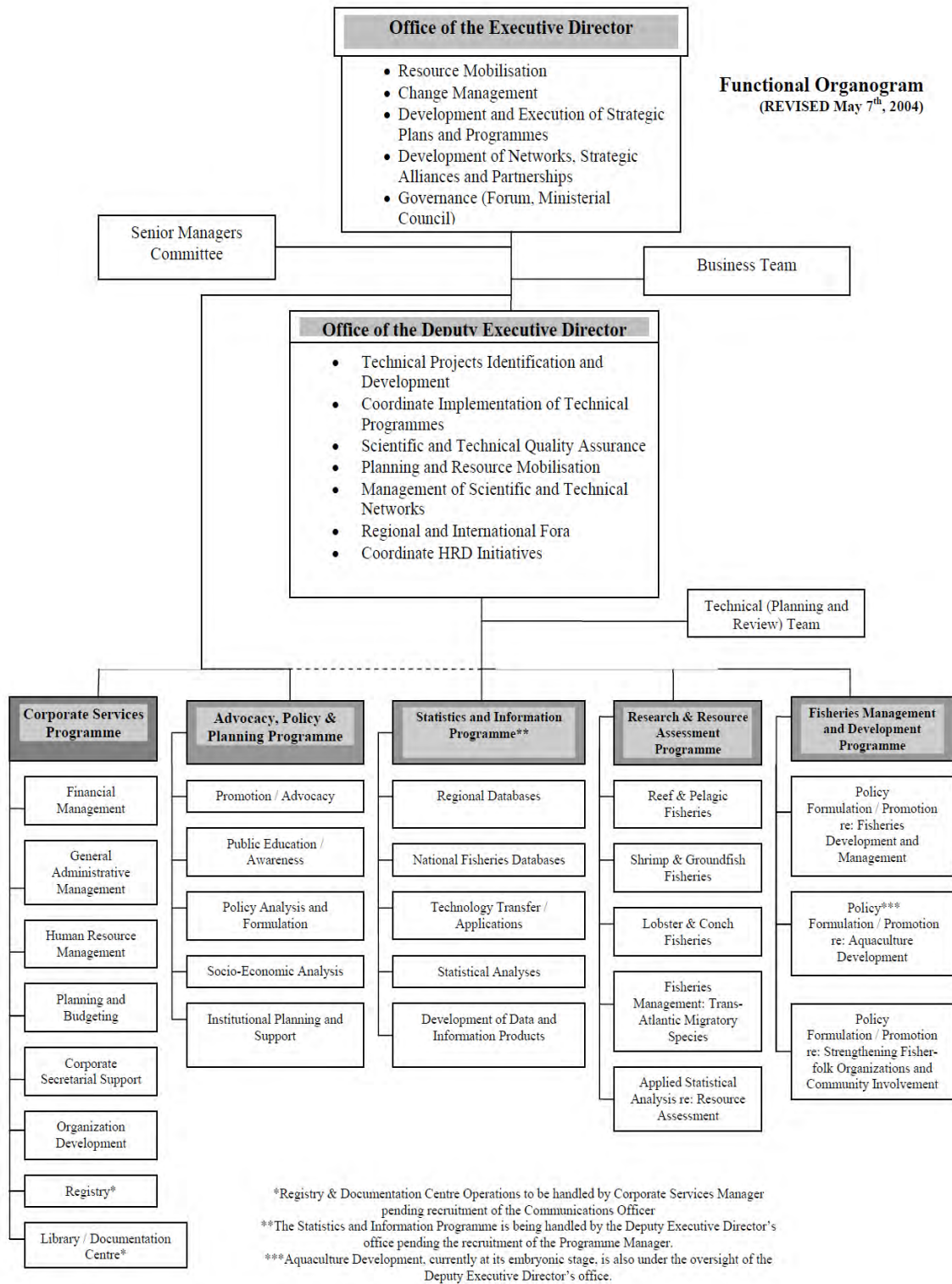
The goals of the CFP are as follows:

- 1) Take appropriate measures for conservation, management, sustainable utilization and development of fisheries resources and related ecosystems.
- 2) Build capacity amongst fishers and optimize the social and economic returns from their fisheries.
- 3) Promote competitive trade and stable market conditions.

The following are the objectives of CFP:

- A) Promote sustainable development of fishing and aquaculture industries in the Caribbean region as a means of( *inter alia*) increasing trade and export earnings, protecting food and nutrition security, assuring supply to Caribbean markets and improving income and employment opportunities;
- B) Develop harmonized measures and operating procedures for sustainable fisheries management, post-harvest practices, fisheries research, fisheries trade and the administration of the fishing industry;
- C) Improve the welfare and livelihoods of fishers and fishing communities;
- D) Prevent, deter, and eliminate illegal, unreported and unregulated fishing through the establishment and maintenance of effective monitoring, control, and surveillance systems;
- E) Build the institutional capabilities of Participating Parties (*inter alia*) to conduct research, collect and analyze data, improve networking and collaboration among Participating Parties, formulate and implement policies and make decisions;
- F) Integrate environmental, coastal and marine management considerations into fisheries policy so as to safeguard fisheries and associated ecosystems from anthropogenic threats and to mitigate the impact of climate change and natural disasters;
- G) Transform the fisheries sector into a market-oriented, internationally-competitive and environmentally-sustainable one based on the highest international standards of quality assurance and both sanitary and phytosanitary systems;
- H) Strengthen, upgrade, and modernize fisheries legislation; and
- I) Facilitate the establishment of a regime for SPS for the fisheries sector.

CRFM Secretariat has been the counterpart organization to the current JICA/CRFM project. Figure 2-1 shows the functional organizational structure of the secretariat.



**Figure 2-1 Organization Chart of CRFM Secretariat (Source: CRFM Second Medium Term Plan)**

## **2.2. Issues of Small-scale Fisheries Resource Management and Development**

During the baseline survey, the situations of the (1) coastal reef fisheries, (2) pelagic fisheries, (3) aquaculture, (4) fisheries statistics, (5) community based resource management, (6) marketing, and (7) regional cooperation were all investigated. Issues identified in these 7 categories are described below.

### **2.2.1. Issues within Coastal Reef Fisheries**

#### **2.2.1.1. Inadequate Monitoring of Coastal Resources**

Coastal reef resources have been well-used by local small-scale fisheries in most of the target countries. However, fundamental information needed to understand the status of coastal reef resources has not sufficiently accumulated in most Caribbean countries. It is necessary to improve by providing efficient monitoring methods and competent data collectors who possess the required knowledge and skills in fisheries statistics, data management, and stock assessment. However, this continuous data collection and adequate training for data collectors has not occurred due to fund shortages or lack of proper educational schemes..

#### **2.2.1.2. Decline of Coastal Reef Resources and Degradation of Habitat**

Some Fishery resources management schemes such as the establishment of marine reserve areas, proclamation of closed season for fishing, and restriction of fishing methods have been implemented in various locations. However, it is often observed that failure or non-fulfillment of efficient coastal resource management is due to lack of social cognition, inadequate surveillance and enforcement system, and/or an inadequately supporting legal systems. For example in Jamaica, the restriction of mesh size was undertaken in the Discovery Bay area with a subset of fishers actually increasing yield by using the prohibited mesh size net while other fishers gradually flouted the restriction. Furthermore, degradation of coral reef due to mass mortality of hermatypic coral after coral bleaching has become a concern in last several decades. This degradation of coral reef which is important as a habitat and nursery ground for aquatic organisms obviously leads to depletion of fishery resources. The fish trap is a popular fishing gear used in the Caribbean to catch fish and lobsters. When it is lost at sea due to bad weather or an accident, it continues to catch fish without being harvested (Ghost fishing). Since the number of traps lost at sea is significant, ghost fishing is considered to contribute to the decline of fish and lobsters.

#### **2.2.1.3. Difficulty in Managing Artisanal Fishery around Coastal Reefs**

The accessible coastal reef is usually fraught with danger of rapid environmental deterioration. Although several activities for coastal resource management have been undertaken so far, many of these activities have had only limited success. The most common cause of unsuccessful coastal resource management is lack of involvement by the local community when reviewing and setting up management rules, most often due to the perceived lack of enrichment to fishers' income and living.

## **2.2.2. Issues within Pelagic Fisheries**

### **2.2.2.1. High Operational Cost**

Trolling fishery is common in some Caribbean countries to catch offshore pelagic fish and requires a high fuel cost for out-board engines. Although offshore pelagic species are not fully exploited, recent increases in fuel prices seriously affects the economics in fishing operations. The Fisher's overall economic condition strongly influences the effectiveness of fisheries resource management measures. As an example, bad economic conditions could force fishers to break management measures to increase his or her individual economic yield to bring in more income.

A Fish Aggregation Device (FAD) has been introduced in some countries to reduce the operation cost of fishing by reducing the time needed to search for a good fishing ground. However poor design, materials, setting procedures, and management cause a shortened life of FADs as well as an increase in fishing operational costs. Conflicts while using FADs induce local fishers to gradually set their FADs at farther distances from the shore, in turn increasing the operational cost even more.

### **2.2.2.2. Insufficient Data Collection for Resource Management of Target Species**

Fish catch data of main offshore species, such as dolphin fish, wahoo, black-fin and yellow-fin tunas, are collected in respective countries. However, periodic biological data collection, which enables analysis of size trends within target species, is not part of data collectors' routine work. Therefore, the quality and quantity of data is insufficient to determine appropriate fishing efforts in regional waters. Data collections are not conducted for clear purposes and in harmonized manners in the region to manage the target fish species by multiple countries. Therefore, appropriate data collection of target fish species utilizing catch, fishing effort, with periodic biological data is a major concern.

Small coastal pelagic species, such as robin and jacks, are generally caught by seine nets. Practically, landing data of seine-net fishing is difficult to collect because seine-net fishers frequently change their landing sites in accordance with the movement of fish schools. Fishing effort data and periodic biological data are also inadequate for assessing the trend within small coastal pelagic species..

### **2.2.2.3. Un-utilized Species**

Even though the diamondback squid resource was discovered in the Caribbean, its utilization has not been promoted. It is because there is no squid market in the region. In addition, local fishers do not recognize the importance of exploring new fisheries resources to mitigate the fishing pressure on the currently exploited pelagic fishes. The diamondback squid resource in the Caribbean may be abundant, and has a potential to contribute to the sustainable use of fisheries resources for coastal communities by diversifying their fishing efforts

### **2.2.3. Issues in Fisheries Statistics**

#### **2.2.3.1. Insufficient Data Collection for Informed Decision Making**

It is generally observed that the statistics policy and procedures are not documented or periodically reviewed to ensure that fisheries statistics supports informed decision making in fisheries management. Outdated or unknown statistical data collection procedure is one of the main reasons why the collected data is not useful for informed decision making in the region.

#### **2.2.3.2. Inadequate Data Management**

In most target member countries, data management shows a high level of deficiency. There is a lack of computer equipment dedicated for the statistics, ineffective and inefficient data management procedures, and an inadequate filing system. Some member countries have also reported losses of data due to an absence of a back-up system.

#### **2.2.3.3. Insufficient Use of The Caribbean Fisheries Information System (CARIFIS)**

CARIFIS is the database program designed to help manage fisheries data in the Caribbean region. The database program had been upgraded with TIP/LRS database as a tool for data encoding, data storage, and querying for data analysis.

CARIFIS provides a variety of data entry menus based on the needs to realize expected results, but it is not based on the needs of the member countries. Technical support to handle data management in the CARIFIS database is limited. Staff trained for CARIFIS sometimes leave the fishery authority without transferring their skills to other staff members, and enough follow-up CARIFIS training has not been provided. Past data such as fishery and vessel registration data in LRS, and catch effort data in TIP are not transferred successfully.

It seems no member country use the CARIFIS software to its full function. Only four member countries use CARIFIS partially, while one member country is in the process of replacing its spread sheets with CARIFIS. The other member countries could be potential users of CARIFIS considering the level of their computer skills and needs.

#### **2.2.3.4. Inadequate Information Dissemination**

Overall, there is not a strong link with the FSS and fishery policy and management objectives. The system in general is not used in a dynamic manner to guide decisions.

Within all member countries, fisheries annual reports are provided by the fishery authority. In some cases (three member countries), the summary of catch information is provided monthly. The monthly report is helpful for fishery managers and any other decision makers to monitor the status of the fisheries sector and deal with arising issues.

#### **2.2.3.5. Gaps in the Human Resources**

In most cases (nine member countries), no fishery statistician is employed and the work is covered by other staff. On the other hand, a data manager or data input clerk is assigned in all the

member countries.

## **2.2.4. Issues within Aquaculture**

### **2.2.4.1. Insufficient Development of Small-scale Aquaculture**

The main target species for small scale aquaculture are tilapia (*Haplosternum* spp), and to a lesser extent freshwater shrimp. In Jamaica, oyster-culture is also practiced on a small scale and is managed by the government. Sea moss and oyster culture have been tried and demonstrated throughout the region; however, no commercial activity currently exists.

Critical to the development of small-scale aquaculture is the provision of basic production inputs e.g. seed, feed, extension service, and market supports. However, the government capacity to provide necessary support is not sufficient in some member countries. Jamaica, Belize, Guyana, and Trinidad have national aquaculture centers and a dedicated aquaculture unit to support small farming activity. St. Lucia is currently building a national aquaculture centre, which is expected to support the seed supply and act as a center of excellence in the subject area of the region. Dominica shows some potential for small-scale aquaculture.

All countries indicated an eagerness to see small-scale aquaculture development; however, careful analysis would be required to determine the viability of such projects.

General Issues of concern to small scale aquaculture development across the region are as follows;

- Shortage of seed supply
- Cost of financing
- Competition for land by tourism/general housing
- High feed costs
- Insufficient extension support
- Insufficient marketing activity
- Theft
- Predation by wild animals
- Insufficient development of cooperative approach
- Insufficient use of integrated farming systems

### **2.2.4.2. Insufficient Research Capabilities**

Except for Jamaica, Belize, and Trinidad (and to a lesser extent Guyana), trained technical personnel are few within the region. There is very little technical exchange within the region possibly due to financial constraints. It may lead total dependence on external support.

### **2.2.4.3. Insufficient Training Opportunities**

Aquaculture training at the technician or skilled level is not easily available, and is a



common constraint for the development of the industry throughout the region. At present, a limited amount of aquaculture research is being carried out by UWI and to a lesser extent by the public sector through their aquaculture units, or specialized agencies such as Institute of Marine Affairs (IMA) in Trinidad and Tobago. Some applied research is also being carried out by the private sector presently involved in commercial aquaculture production. Available scientific, technical and production information is mainly managed by organizations external to the region, and for the time being no specific system for Caribbean aquaculture exists.

#### **2.2.5. Issues on Marketing**

##### **2.2.5.1. High Price of Offshore Pelagic and Demersal Fish**

Generally, local fishers use outboard engines and use trolling and long-line fishing for offshore pelagic fish and bottom-line fishing for demersal fish. Therefore, fishers use large quantities of fuel traveling to offshore fishing grounds. Currently, high market prices of offshore pelagic and demersal fishes may compensate the high fuel costs.

Another source of animal protein is domestic or imported chicken and is consumed commonly by local people. Since the price of chicken is almost half of the fresh fish price, consumers usually find local fish very expensive, especially offshore pelagic and demersal fishes. Therefore, those high-priced fishes are dealt mainly in the tourism industry. It causes a low demand of local consumers for offshore pelagic and demersal fishes.

Coastal pelagic fish are used as live bait in trolling and long-line fishing in large quantities for tuna, marlin and king fish. However, this sale causes a short supply of the affordable fish for local consumers in local markets.

##### **2.2.5.2. Fluctuation of Regional Fish Demand by the Tourism Industry**

The number of tourists visiting the Caribbean region largely fluctuates throughout the year, the peak season from December to April and the off season from May to November. This business fluctuation affects the fish demand of the Caribbean region. It means that the regional fish demand rises in the peak tourism season and drops in the off season. Therefore, in the peak tourism season, a hotel or a restaurant cannot procure necessary amount of fish in local markets; and then it purchases imported fish. Meanwhile in the off season, fresh fish often flood local markets.

In St. Lucia, the Fish Marketing Corporation (FMC) purchases fish from local fishers and preserves them in freezers and cold storages during the off tourism season. However, the operational cost of storage facilities is high, especially in electricity cost. It is a financial burden for the FMC management. Recently, fish products have been imported from other regional or outer regional countries at lower prices. Gradually, this import of fish will threaten the sale of domestic frozen fish.

### **2.2.5.3. Failure in Management of Fisheries Distribution Facilities by Fishermen Cooperatives**

Fish distribution facilities such as landing places, fish markets, and ice making plants are generally well developed in the Caribbean region. In most cases, fisheries cooperative associations (FCA) composed of local fishers are entrusted to operate the facilities for local fisheries development. In practice, however, it is too difficult for local fishers to sustain the fisheries facility operation themselves, resulting in the governmental fisheries authorities like fisheries department or public fisheries corporations taking over the facility operation.

### **2.2.6. Issues on Community Based Resource Management (CBRM)**

#### **2.2.6.1. Weak Organization Capacity**

The existence of community organizations and its capability would determine the feasibility of CBRM in respective areas. In many communities without an organization, local fishers do not realize the real benefit of community organization. Some communities are unable to formulate due to insufficient capabilities even if they need an organization. In such a case, fishers realize the need for an organization in order to deal with issues which can hardly be solved by individual fishers, such as market development and alternative income generation. There have been small informal groups of fishers who have a common interest in these areas although they cannot be called an organization yet.

Even though there were community organizations which implemented resource management activities, many organizations cannot sustain their activities due to the lack of management capacities and funding. Some community organizations have no or only a few activities. According to the field survey, there are the following types of organizations which 1) lost its centripetal force due to diversified activities of fishers, 2) have been organized for a project supported by government or other donors and then stopped its activities after project termination and 3) has provided an infrastructure and certified as a community organization by a government or donor agency but had no specific activities from the beginning.

#### **2.2.6.2. Concerns over Fishers' Income Decrease**

One of the biggest obstacles in community participation is the reduction in fishers' income caused by resource management activities. According to the interview survey, most coastal small-scale fishers in the region are not economically stable and would not tolerate an income decrease, even in the short term. This fact suggests that implementation of fisheries management measures alone may not ensure full compliance of such measures by fishers.

#### **2.2.6.3. Weak Communication between Fishery Authorities and Fishers**

As mentioned earlier, CBRM can be facilitated not only with a bottom up approach but also by collaborative activities with community and fishery authorities. Therefore, the establishment of a communication flow between two parties is very important in initiating

CBRM. Some fisheries departments/divisions in the region assign extension workers to facilitate communication with the fishing communities, however, there is still room for improvement in order to integrate community opinions into fishery policies strategically. The low level of education and literacy, physical distance, and the cost of traveling may remain as barriers to smooth communication. The mechanism and structure to involve fishers, their organizations, and communities in fisheries management need to be reviewed and reformed, if necessary.

#### **2.2.6.4. Encouragement of Women Participation**

In many coastal areas in the Caribbean region, fishing activities extend for several days. Generally, fishers tend to adhere to their traditional ways and show little enthusiasm to change their fishing activities. Only a few fishers would join CBRM activities to generate alternative income resource. The survey has found many communities where women's power is not well utilized and women's participation could help facilitate community based activities and make CBRM more sustainable, for instance, in fish processing.

#### **2.2.6.5. Involvement in Tourism Sector**

The tourism sector has close linkage with the fisheries industry in the Caribbean region. Even though the tourism sector shares the coastal area with the fisheries, the relationship between the two parties is not necessarily good. Many fishers complain about tourism development in terms of environmental deterioration and fishing ground degradation. While some fishers have an interest in tourism activities since it may be more lucrative and active in the off season of the fishery. Thus, the tourism sector and the fisheries sector are inseparable for the coastal community and a strategy of cooperation is essential to avoid conflict. There is need for improved coastal zone management and inter-sector planning.

### **2.2.7. Issues within Regional Cooperation**

#### **2.2.7.1. Management of pelagic fish resources**

Regarding the pelagic fishery, the CARICOM member countries are minor fishing countries as compared to those major fishing countries such as Guadeloupe, Cuba, and Puerto Rico. Since pelagic resources are shared resources in the region, management efforts conducted only by CARICOM member countries would not be effective enough. Nevertheless it is still a requirement of fishing countries that they provide reliable data and information on pelagic resources in order to support better management of these resources in the Caribbean Sea area.

#### **2.2.7.2. Technical Cooperation in the Region**

Many CARICOM member countries have both small economies and populations and the number of staff working for the fisheries department as well as their budget for activities is limited. CRFM therefore provides needed assistance to member countries not only with political issues such as a review of a fisheries act and preparation of a fisheries management plan but

also on technical issues such as resource surveys and building a fisheries statistical system. The Annual Scientific Meeting commemorated the 5th consecutive year and conducted discussions and data analysis methodology as an on the job training. Nevertheless, as there are unique problems in each country, there is a limit to group training. Fisheries and aquaculture technical trainings are conducted sporadically, and the regional training centers act only as a national center and not contributing to the region.

### **2.3. Summary of Issues in Fisheries Resource Management of Small-scale Fisheries**

As referred to mainly in 2.2.1., one of the issues in coastal fisheries was the decline of coastal resources and degradation of habitats. Considering the insufficient surveillance and enforcement activities, preparation of management plans is indispensable to formulating workable resource management. Thus the first issue can be stated as;

- 1) Inadequate or outdated fisheries resource management and development policies and plans, which are not based on appropriate management strategies/measures at the national and regional levels.

As referred to mainly in 2.2.2., although offshore pelagic fish are under-exploited, the increasing cost of fuel has been affecting the profit of fishers. Inadequate design of FADs and deployment also contributes to the higher operational cost. Diamond back squid exist in the region but its fishing method and marketing has not been developed. Thus the second issue can be summarized as;

- 2) Insufficient efforts to diversify and/or improve economic efficiency of fisheries, which may discourage fishers to actively participate in fisheries management activities.

As referred to mainly in 2.2.3., inadequate monitoring of coastal and pelagic resources was identified. Fisheries statistics system is not documented or periodically reviewed to ensure that the FSS is guiding decisions relevant to the fisheries management goals and objectives. Data management and information dissemination are weak. Thus the third issue was recognized as;

- 3) Weak fisheries statistical system, which fails to provide essential information to manage and develop fisheries.

As stated in 2.2.6.2, it is important to maintain the income of fishers when resource management measures are implemented. Since diversification of capture fishery to compensate for the loss in income from current fishery is crucial, it is desirable to develop alternative income generating activities. In the Study, aquaculture was viewed as an alternative income source for small-scale fishers. As referred to mainly in 2.2.4, there was strong desire for aquaculture development in the region. Thus the fourth issue can be defined as;

- 4) Limited opportunities for alternative income generation, which constrains a sustainable

livelihood for fishers and coastal communities.

As referred to mainly in 2.2.5., the high price of offshore pelagic fish and the inappropriate distribution of coastal pelagic fish were identified. Diamond back squid is a new product and the local market has not yet been developed. Aquaculture products also have a marketing problem. Thus the fifth issue can be described as;

5) Lack of effort in developing fish marketing and also in value addition (fish processing)

As referred to mainly in 2.2.6., both the community and fishers participation in data collection as well as in resource management activities was found essential. The major issue affecting this lack of community participation been identified as the decline of income due to restrictions placed on the use of resources. Thus the sixth issue was identified.

6) Insufficient involvement of fishers in resource management activities.

As referred to mainly in 2.2.7, the fisheries authorities in the CARICOM member countries are small due to the scale of economies and size of population and it is thus difficult to have sufficient staff in fisheries statistics, fishing technology, and aquaculture. At the policy level, fisheries management plans are not fully developed in many member countries. One of the important roles of CRFM Secretariat is to provide assistance to member countries. Even though the CRFM Secretariat does not have specialists in all technical fields, it can still coordinate necessary assistance drawn from the region and beyond. Each country also seeks overseas bilateral assistance. However, these activities are country based and not normally shared in the region. Sharing technologies and expertise are not systematically done due to insufficient communication among member countries. Regional expertise is under-utilized due to limited funding and conditional ties of the donor agencies. Thus the seventh issue was mentioned as;

7) Weak regional networking systems/strategies.

### 3. Pilot Projects

#### 3.1. Purpose of Pilot Projects and their Selection Process

In the previous chapter, seven critical concerns were identified. Pilot projects were designed to improve the situation of resource management focused on these concerns. Accordingly, a list of potential pilot projects were identified and put together through the analysis of data and information collected during the baseline survey. From this list, five generalized pilot project ideas were prepared (Table 3-1, The long list is presented as Table 3-2) and presented at the first steering committee meeting held in St. Vincent and the Grenadines in December 2009. This process was necessary to obtain active participation and cooperation of the CARICOM member countries.

**Table 3-1: Proposed Five Pilot Project Ideas**

<ol style="list-style-type: none"><li>1. Stock Enhancement Trial of the Caribbean Spiny Lobster</li><li>2. Sustainable Development and Management of Offshore Pelagic Fishery</li><li>3. Improvement of the Fisheries Statistical System</li><li>4. Sustainable Freshwater Aquaculture Development and Management for Low-income Populations</li><li>5. Study of the Advancement of Intra-regional Marketing (Market Advancement Project)</li></ol>
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Project idea number 1 was designed for testing stock enhancement of spiny lobsters as a resource management measure with community participation. However, this idea was omitted at the steering committee meeting as a similar project had just started in Jamaica with the technical assistance of Cuba. It was also pointed out that the outcomes of stock enhancement activities would not be obtained in one or two years.

Project idea number 5 was also omitted because very few countries considered the marketing problem a priority.

Project ideas 2 through 4 were accepted by the steering committee and the ideas were further spelt out and developed into the pilot project-implementation plans. All the three pilot project ideas were formulated on the basis of the guiding principles of participatory resource management and a regional network.

Pilot project number 2 dealt with the diversification of fisheries through utilization of less utilized as well as unutilized resources. This pilot project also dealt with resource management measures such as formulation of a management plan with a limited entry system in mind.

Pilot project number 3 focused on the improvement of the fisheries statistical system. This

pilot project also dealt with fishing boat registration and fishing license issues, which are considered part of resource management measures.

Pilot project number 4 was intended to deal with three main issues faced by small-scale aquaculture development, namely, high feed cost, inadequate extension methodology, and national and regional aquaculture development plans.

Background and purpose of each pilot project is presented in the following sections.

**Table 3-2: Long List of Potential Fisheries Project in the CARICOM Member Countries**

No		Country Name	Project category 1	Project category 2	Project category 3	Project category 4	Project category 5
			Offshore Pelagic Fisher	Aquaculture	"Stock enhancement	Statistical data management	Marketing Advancement
1	Countries with wide continental shelves	Guyana		Development of small scale integrated tilapia culture by women's group		Improvement of fishery statistic data collection and analysis	
2		Suriname		Development of small scale fish culture		Improvement of fishery statistic data collection and analysis	Product Development and Marketing (Value Chain)
3		Trinidad in and Tobago		Establishment of a finfish mariculture		Establishment of statistic data base	Improvement of data collecting system of coastal pelagic fishery
4	Countries with large land area and well-developed coral reefs	Jamaica	Development of offshore pelagic and diamond-back squid fishery	Training of extension officer and community leader for aquaculture of tilapia and tropical fish culture	Stock enhancement of spiny lobster		
5		Haiti		Development of small scale inland fish culture (training)	Combination of sea-moss aquaculture and stock enhancement of spiny lobster		
6		Belize	Development of offshore pelagic fishery	Training for small scale tilapia culture	Combination of sea-moss aquaculture and stock enhancement of spiny lobster		Preparation of coastal reef habitat and resource map
7	Countries with small land area	Antigua and Barbuda	Training program for diversification of coastal small-scale fishery		Coastal resource management for spiny lobster and queen conch		Study on occurrence of Ciguatera poisoning
8		Barbados	Development and management of year-round offshore pelagic fishing		Development of community based resource rehabilitation model		Development and management of new type demersal fishing
9		Dominica	Development and management of community participatory pelagic fisheries resource			Improvement of statistic data collection and analysis	
10		Grenada	Reasonable off-shore fishery by introducing shallow water FAD			Improvement of fishery statistic system and data management	Live bait rearing by cage net and delivery management Improvement of quality of fish product for development of new market
11		St. Lucia	Management of off-shore fishery utilizing FAD		Resource management for reef fishes and spiny lobster	Improvement of fishery statistical systems	Improvement of resource management of coastal pelagic fish
12		St. Kitts and Nevis	Development and management of pelagic fishery by utilizing FAD	Development of tilapia culture with natural food			
13		St. Vincent and the Grenadine	Development and Management of FAD fishery			Improvement of statistic data collection and analysis system	Management of coastal pelagic fish fishery by monitoring of beach seine
		Tobago in Trinidad and Tobago	Development and Management of less utilized Dolphinfish fishery (Tobago)			Resource survey of the queen conch in Tobago	



### 3.2. Selection of Pilot Project Implementation Countries

As the pilot projects were implemented through the initiative of the host countries, the member countries were asked to identify their priorities for pilot projects (Table 3-3).

**Table 3-3: Priority List in Pilot Project Categories**

Country	Pilot project categories				
	Offshore pelagic	Freshwater aquaculture	Statistical system	Coastal resource management	Market advancement
Guyana		2 <sup>nd</sup>	1 <sup>st</sup>		
Suriname			2 <sup>nd</sup>		1st (with food processing for added value)
Trinidad and Tobago		2 <sup>nd</sup>	1 <sup>st</sup>		
Jamaica	2 <sup>nd</sup>	1 <sup>st</sup>			
Haiti	1 <sup>st</sup>	2 <sup>nd</sup>			
Belize	2 <sup>nd</sup>	1 <sup>st</sup>			
Antigua and Barbuda					
Barbados	1 <sup>st</sup>			2 <sup>nd</sup>	
Dominica	1 <sup>st</sup>		2 <sup>nd</sup>		
Grenada			2 <sup>nd</sup>		1st (live bait & marketing)
St. Lucia	1st (with marketing)		2 <sup>nd</sup>		
St. Kitts and Nevis	1 <sup>st</sup>	2 <sup>nd</sup>			
St. Vincent and the Grenadines	1 <sup>st</sup>		2 <sup>nd</sup>		

The criteria suggested in the inception report were used to arrive at a shortlist of potential projects.

#### Criteria for short listing

- Leaders of the target community approve the project.
- Projects contribute to enhanced relationships among the fisheries community.
- Projects have no negative environmental impacts.
- Geographical balance and fairness maintained in the region.
- Capability of fisheries agencies and research institutes, such as a survey vessel, assignment of a counterpart, and a working office for Japanese experts, exists in the target country.
- There are no duplicating projects
- Pilot project site has a safe environment.

A total of six pilot projects were chosen and finalized; namely, two pilot projects for the offshore pelagic fishery development and management, two pilot projects for small-scale aquaculture development and extension, and two pilot projects for the improvement of fisheries

statistics.

The candidate countries for pilot project were selected on the basis of the priority list of the member countries (Table 3-3), short-listing criteria of pilot projects, and discussion among the member countries.

The following countries were chosen for each pilot project:

<b>Pilot Project</b>	<b>Host Country</b>
Coastal fisheries resources management (incl. Pelagic and Demersal species) Pilot Project	St. Lucia, Dominica
Aquaculture Pilot Project	Jamaica, Belize
Fisheries Statistics Pilot Project	St. Vincent and the Grenadines, Guyana

The Study team members and CRFM Secretariat staff member made initial visits to the pilot project candidate countries and engaged in a series of discussions with chief fisheries officers, core staff of the fisheries departments/divisions. Ministers, Permanent Secretaries in charge of fisheries, and persons in charge at the Ministry of Foreign Affairs were also visited to secure support for the pilot projects. The detail of the pilot projects are presented below.

### **3.3. Implementation of the Pilot Projects**

Actual implementation of the pilot projects began in May to September 2010, depending on the progress of the above-mentioned preparation period. The implementation period was set at one year to one-and-a-half years.

Local consultants were contracted for each pilot project to manage its day-to-day activities, as a means of support to the host country's fisheries staff. During the course of implementation, the Study team members and CRFM Secretariat staff visited the pilot project sites frequently to monitor and provide guidance on the implementation of the activities. Adjustments were made when needed. The sections that follow describe the results of the pilot projects.

### **3.4. Pilot Project on Pelagic Fishery Resource Development and Management**

#### **3.4.1. Background of the Project**

One of the main issues of fisheries resource management in the region is declining tendency of coastal fisheries resources year after year, because of excessive fishing pressure on coastal demersal and reef species and degradation of the coastal marine habitats. Therefore, diversification of fisheries, such as the utilization of under or unutilized migratory pelagic resources, becomes an important option.

The FAD fishery has an important role to shift small-scale fishers from coastal to offshore resources without causing any short term economic loss. From this perspective, Dominica and St. Lucia have succeeded in the introduction and development of the FAD fishery using their

respective approaches. Monitoring and management of the FAD fishery and associated pelagic resources, however, remain inadequate, and new problems have also emerged in each country's present circumstances.

Therefore, the pilot projects for FAD and associated pelagic fishery resource management were implemented in both Dominica and St. Lucia, where the FAD fisheries are advanced, but the islands have reached a turning point at which they must seek and attempt better approaches to realize sustainable FAD and associated pelagic fishery management. It was recognized that FAD fishery management need precautionary approach, given the potential to focus fishing effort on vulnerable stages in the life history of species that can have negative impacts on the population. The monitoring systems to ensure the timely action for the management would have to be put in place.

Through activities in each pilot project, approaches such as participatory community-based monitoring and management of FAD fisheries and associated pelagic resources have been examined and further developed, and the lessons learned in each might be utilized for other countries in the region that have a similar fisheries structure and keen interest in utilizing FAD for pelagic fishery management.

#### **3.4.1.1. Situation of Dominica When the Pilot Project Started**

In Dominica, there had been no restrictions regarding deployment of FADs, and all the FADs in use had been deployed by individual fishers/fisher groups since early 1990. Therefore, FAD owners/fishers did not want other fishers to use their FADs, and there were always conflicts between fishers. Vandalism caused by conflict was one of the main reasons for the loss of FADs. In order to improve the situation, the Fisheries Division guided the National Association of Fishers Cooperatives (NAFCOOP), the umbrella organization of all fishers' cooperatives, to become a partner of the FAD fishery management body. A series of consultations between the Fisheries Division and NAFCOOP with affiliated fisher co-ops were held, and these resulted in a consensus that NAFCOOP would manage all FADs. Draft regulations on the FAD fishery which supports NAFCOOP as the management body of FAD fishery in Dominica were formulated and were expected to be passed by the parliament in September 2010. It was still under discussion as NAFCOOP needed to develop a stronger organizational capability to realize the new system of FAD operations.

#### **3.4.1.2. Situation of St. Lucia When the Pilot Project Started**

With the introduction of FAD fishing to St. Lucia, the Department of Fisheries (DOF) had deployed most of the FADs and made available to all fishers. Fishers and fisher cooperatives have played a role in assisting DOF, but on ad hoc basis. Though there has been less conflict between fishers related to FAD usage compared with Dominica, DOF has to secure enough funds to deploy FADs in the waters every year as FADs get lost frequently.

When FADs were lost and DOF could not be replaced on time, fishers were often obliged

to use a limited number of FADs, even in the high season. Such overcrowded FADs (i.e., too many fishers at a FAD at one time) tended to reduce the productivity of the FAD fishery. Moreover, fishers tended to demand DOF to deploy FADs at varying distances from the shore, even though this would increase operational costs. Therefore, in the context of the worldwide recession and limited funds available for new FADs, there was urgent need to review the existing system so as to ensure the economic sustainability of FAD fishery. This would require co-management by DOF and fishers/fishers organizations with an appropriate FAD fishery management plan.

### **3.4.2. Purpose of the Project**

The purpose of the pilot project was to ensure the economic sustainability of FAD fishery through community participatory FAD/pelagic fishery resource development and management as a coastal fishery resource management model.

Expected outputs were as follows:

- a. Improved capability of FAD and associated pelagic fishery resource management on the part of the fisheries officers and fishers/fishers organizations
- b. Increased productive outputs of FAD and associated pelagic fishery resource by developing the skills and capacity to utilize potential species

### **3.4.3. Activities and Achievement**

#### **3.4.3.1. Results of Baseline Surveys**

A baseline survey on FAD fishery was conducted in April 2010. This was followed by a workshop in May 2010. The present status and issues of FAD fishery were studied and ideas for modified FAD design, construction, deployment, monitoring and management were discussed at the workshop.

The results of the baseline surveys in Dominica and St. Lucia confirmed that FAD fishing is a very important form of fishing and a main contributor to increased catches of ocean pelagic species. They indicated that there is an interrelation between FAD fishery's contribution to sustainable catches of ocean pelagic species and mitigation of fishing pressure on reef and demersal fish resources (Appendix 5).

The original design of the FADs used in Dominica and St. Lucia came from Martinique, a French island. However, fishers in Dominica have further developed the FADs on their own initiative using locally available materials and limited financing, relying only on their experience.

The types of FADs used in the beginning of the pilot project, methods of fabrication, deployment, safety, and type of gears are described in the reports on the Baseline Survey and

Workshop in Dominica and St. Lucia (CRFM 2010a, b, c & d)<sup>6</sup>. The main technical issues for FAD fishing in Dominica and St. Lucia were 1) FAD submersion problem and 2) loss of FADs. These problems directly resulted in a) reduction in operation days and b) increased operational cost for fishers. Other key findings during the baseline surveys are as follows.

Fuel cost was 70 - 90% (Dominica) and 75 - 85% (St. Lucia) of daily operational cost for FAD fishing. The annual increment of fuel prices was one of the main concerns for FAD fishers. In Dominica, leading FAD fishers had already switched from a two-stroke to four-stroke outboard engine (OBE) whose fuel consumption rate is 45% lower than the two-stroke OBE. In St. Lucia, the four-stroke OBE has not been widely used. In both countries, the two-stroke OBE was a standard for small-scale fishing boats.

In Dominica, 28 FADs were identified. Most FADs are 10 - 20 NM (nautical miles) offshore east and west; some are more than 40NM away from the shore. Most FADs are placed at the depth of 1,500 - 2,500 m; some are more than 3,000m in depth. In St. Lucia, 10 FADs were identified at the depth of 1,000 - 2,000 m and were 5 - 15 NM east and west, but 6 of the 10 had already been lost at the time surveys were conducted.

#### **3.4.3.2. Introduction of Modified FAD**

In order to address the issues identified above, modified FAD was designed to minimize these problems, which Dominica fishers evaluated as being much better than traditional FADs, whereas St. Lucia fishers were still unsure of its performance. The result of the evaluation questionnaires among FAD users showed superior performance by the modified FAD compared with the traditional FAD, including its construction, deployment, and maintenance (Tables 3-4 and 3-5).

The main modifications made to the traditional FAD include the use of mid-water buoys to reduce submersion rates, the use of sandbag anchors to increase anchor weight and deployment safety, and the adaption of mooring ropes with appropriate length, weight, and lightness on the basis of basic knowledge and calculations. Locally available materials were applied as much as possible. The details of the modification process are described in the reports of FAD fishery management workshop #1 held both in Dominica and St. Lucia (CRFM 2010e & 2011a)<sup>7</sup>.

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<sup>6</sup> Output documents related to the pilot projects in Dominica and St. Lucia are to be published as;  
*Report on Baseline Survey in Dominica*, (CRFM), Technical and Advisory Documents, 2010a  
*Report on Baseline Survey in St Lucia*, (CRFM), Technical and Advisory Documents, 2010b  
*Report on Baseline Survey Workshop in Dominica*, (CRFM), Technical and Advisory Documents, 2010c  
*Report on Baseline Survey Workshop in St Lucia*, (CRFM), Technical and Advisory Documents, 2010d

<sup>7</sup> Output documents related to the pilot projects in Dominica and St. Lucia are to be published as  
*Report on FAD fishery management workshop #1 in Dominica*, (CRFM), Technical and Advisory Documents, 2010e  
*Report on FAD Fishery management workshop #1 in St Lucia*, (CRFM), Technical and Advisory Documents, 2011a

**Table 3-4: Results on Evaluation of NAFCOOP (Dominica)****Comparison of Modified FAD to Traditional FAD**

Modified FAD Evaluation	Positive	Neutral	Negative	Total
Construction method	1 (easier)	29 (similar)	0 (more difficult)	30
Deployment method	23 (easier)	7 (similar)	0 (more difficult)	30
Deployment method (Safety)	29 (safer)	1 (similar)	0 (more dangerous)	30
Maintenance method	10 (easier)	20 (similar)	0 (more difficult)	30
Fishing performance	5 (better)	25 (similar)	0 (worse)	30
Submersion rate	30 (less)	0 (similar)	0 (high)	30
Durability	19 (longer)	9 (similar)	2 (Not sure)	30

Note: 30 responses from 9 main fishing communities: 1 in Anse De Mai; 11 in Roseau; 1 in Colibistrie; 1 in Fond St. Jean; 5 in Portsmouth; 3 in Mahaut; 4 in Marigot; 2 in Dublanc; and 2 in Scotts Head

**Table 3-5: Results on Evaluation of DOF (St. Lucia)****Comparison of Modified FAD to Traditional FAD**

Modified FAD Evaluation	Positive	Neutral	Negative	No response
Construction method	6 (easy)	2 (similar)	8 (difficult)	4 (no experience)
Deployment method	12 (easy)	5 (similar)	0 (difficult)	4 (no experience)
Deployment method (Safety)	12 (safe)	5 (similar)	0 (more dangerous)	4 (no experience)
Maintenance method	3 (easy)	15 (similar)	3 (difficult)	
Fishing performance	3 (better)	10 (similar)	5 (worse)	3 (still being monitored)
Submersion rate	6 (less)	8 (similar)	3 (high)	4 (still being monitored)
Durability	3 (longer)	2 (similar)	2 (shorter)	14 (still being monitored)

Note: 21 responses: 20 fishers (7 in Vieux Fort, 1 in Micoul & 13 in Soufriere) and 1 DOF vessel crew

**3.4.3.3. Results of FAD Fishery Monitoring Activities**

In St. Lucia, workshop discussions in the target communities led to proposals for workable ideas for a FAD fishery co-management plan, such as collaboration in FAD construction, deployment, maintenance, monitoring and financial management activities. FAD monitoring activities, such as catch/effort on FAD, FAD maintenance, and biological data collection for target species, had been conducted by a monitoring team equipped with selected monitoring fishing boats in Vieux Fort and Soufriere as well as data collectors in collaboration with participating fishers at both sites. Data collection was regularly conducted. The number of FAD visits, available FADs, fish captured around FADs, boats observed fishing around FADs, and gears used to fish around FADs were analyzed along with dolphin fish biological data (CRFM 2011e)<sup>8</sup>.

In Dominica, under the Fisheries Division/NAFCOOP co-management, a voluntary group of fishers was selected for catch and effort and target fish biological data collection. However,

<sup>8</sup> Output document related to the pilot project in St. Lucia is to be published as *Report on FAD fishery management Workshop #3 in St Lucia*, (CRFM), Technical and Advisory Document, 2011e

the data collection was not very successful. Only yellowfin tuna biological data for a few months were collected at one site (CRFM 2011d)<sup>9</sup>.

#### **3.4.3.4. Results of Activities Related to Implementation of FAD Fishery Co-management Plan**

In Dominica, a licensing system for FAD fishing was introduced on a limited scale through a cooperative arrangement between the Fisheries Division and NAFCOOP. A landing (users) fee collection rule was also established. This system contributes to reduce user conflict in FAD fishing, however, it is now done on a voluntary basis and needs to be backed up by formal legislation. It is essential that the license fee and landing fee should be properly collected to ensure this system's sustainability. There were strong recommendations from participating fishers on the necessity of a formal regulation on FAD, and more involvement of fishers themselves in the FAD fishery management.

In St. Lucia, a working group comprising of the St. Lucia Fisher Folk Cooperative Society (NFO) and DOF was established. An action plan for the establishment of a FAD fishery management body was also created. On the basis of the plan, consultations with each fishers cooperative have been started, but NFO's commitment was inadequate due to its currently limited capacity (this entity was recently launched and has no full-time personnel available as yet).

In the FAD fishery management workshop #3, DOF and five highly motivated fishers cooperatives agreed to present the draft FAD fishery co-management plan and the amended draft FAD fishery regulation, including deployment, monitoring, and fund generation activities, to other fisher cooperatives for their approval. Incremental progress is being made toward the realization of co-management of the FAD fishery, although it will require more time and effort to finalize the co-management plan and the FAD fishery regulation on the basis of consensus among all stakeholders.

The result obtained through the implementation of pilot projects in Dominica and St. Lucia was summarized as draft FAD fishery management plan (Appendix 6).

#### **3.4.3.5. Diamondback Squid Development and Marketing**

Research on fishing, processing, and marketing of diamondback squid (DBS), which is currently unutilized in Dominica and St. Lucia, is underway and could contribute to the potential increase of FAD fishers' productive output.

In Dominica, the DBS working group, which comprises of participating fishers, NAFCOOP, Fisheries Division, and the Newtown Fisheries Cooperative, has been conducting weekly experimental fishing and marketing activities since January 2011. 35 DBS in total were caught in 25 fishing trips, yielding 700 lbs of final products (frozen vacuum-packed fillet). Fishing,

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<sup>9</sup> Output document related to the pilot projects in Dominica is to be published as *Report on FAD fishery management Workshop #3 in Dominica*, (CRFM), Technical and Advisory Document, 2011d

handling, and processing technologies have already been transferred to the fishers and the processing staff in Roseau fish market (CRFM 2011b)<sup>10</sup>. Under the experimental marketing, the market price, EC\$26/lb for the final product, was calculated that provides EC\$14/lb as the raw material purchasing price and the fisher's margin (25%), and EC\$21 as the marketable product cost and the processor's margin (25%). Even though EC\$14/lb is almost 150–200% of the normal fish price, it has been accepted in niche markets such as tourist restaurants and hotels as high quality local delicacy. The fishers are confident they can increase DBS catch if the market can be further developed in the future, in the light of the consistent catches under the experiment.

In St. Lucia, two DBS working groups, one for experimental operations and the other for marketing, were established. They comprised of workshop participants, DOF staff, a marketing unit under the Ministry of Agriculture, St. Lucia Fish Marketing Corporation Ltd., JICA experts, and JOCV. An action plan for experimental operations and marketing of DBS was prepared. On the basis of the action plan, DBS development and marketing activities were undertaken. Nine DBS experimental fishing trips were conducted from January to April 2011, during which nine DBS in total were caught, yielding 140 lbs of final product. Fishing, handling, and processing technologies have already been transferred to the fishers and the DOF staff (CRFM 2011c)<sup>11</sup>. The DBS marketing group held a tasting session, inviting many chefs from tourist restaurants and hotels. They expressed keen interest in DBS products as high quality local delicacy, however, sales of DBS have not started yet due to insufficient marketable stock.

The DBS working group made a new action plan to restart test fishing in October 2011. Research activities will continue for at least one year.

#### **3.4.3.6. Textbook Preparation**

Through the pilot project activities, FAD fishery textbooks (parts 1 - 4) and DBS textbooks (parts 1 - 3) with associated training videos were produced for intended use in the region (CRFM 2011f, g, h, I, j, k & l)<sup>12</sup>. The basic concept for the format of the textbook is to provide a reference book that fishers can easily understand and that can be easily modified in the future. With this in mind, PowerPoint textbooks were used with linked video.

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<sup>10</sup> Output document related to the pilot projects in Dominica is to be published as *Report on FAD fishery management Workshop #2 in Dominica*, (CRFM), Technical and Advisory Document, 2011b

<sup>11</sup> Output document related to the pilot projects in St. Lucia is to be published as *Report on FAD fishery management Workshop #2 in St Lucia*, (CRFM), Technical and Advisory Document, 2011c

<sup>12</sup> Output documents related to the pilot projects in Dominica and St. Lucia are to be published as *FAD Fishery textbook <part 1. FAD design and construction>*, (CRFM), Technical and Advisory Document, 2011f *FAD Fishery textbook with video <part 2. FAD deployment>*, (CRFM), Technical and Advisory Document, 2011g *FAD Fishery textbook with video <part 3. FAD fishing >*, (CRFM), Technical and Advisory Document, 2011h *FAD Fishery textbook <part 4. FAD fishery management plan>*, (CRFM), Technical and Advisory Document, 2011i *DBS Fishery text book <part 1. Ecology and biology of DBS>*, (CRFM), Technical and Advisory Document, 2011j *DBS Fishery textbook with video <part 2. DBS fishing gear and method>*, (CRF), Technical and Advisory Document, 2011k *DBS Fishery textbook with video <part3. DBS handling, processing and marketing>*, (CRFM), Technical and Advisory Document, 2011l



In both Dominica and St. Lucia, comprehensive FAD fishery co-management activities have been improving the FAD and associated pelagic fishery resource management capability of the fisheries officers and fishers/fishers organizations.

Moreover, the potential productive output of FAD and associated pelagic fishery resource has increased in Dominica and St. Lucia due to research and technology development, such as modification of the traditional FAD and development of DBS fishing grounds, as well as experimental marketing by fisheries officers, fishers/fishers organizations, and the working group.

#### **3.4.4. Lessons Learned**

##### **3.4.4.1. Co-management Approach**

###### ***a. Favorable Conditions and Timing for Co-management Approach***

In countries like Dominica and St. Lucia, the fisheries division/department have limited human, institutional, and financial resources to undertake FAD fishery management tasks alone, but have good collaborative links with fishers' organizations. On the other hand, FAD fishers are aware that some action by themselves is necessary for the resolution of conflict and for the sustainable and stable FAD fishing activities, but they also understand that individual fishers cannot solve these issues on their own. Under these conditions, co-management could be a very effective alternative.

###### ***b. Showing Clear and Visible Benefit is the Key to Successful Co-management***

To obtain fishers' involvement in and commitment to co-management, clear and visible benefits must be shown. In Dominica and St. Lucia, fishers already understand that FAD fishing has brought them benefits. In Dominica, the newly introduced modified FADs proved beneficial for fishers, which attracted the interest of fishers and created an opportunity to promote the new management system.

###### ***c. License System***

Open access fisheries are common in the region and individual user's responsibility may be unclear. It is very difficult for the fisheries authorities to manage and regulate the fishery under open access. Dominica's licensing system for FAD fishing is still on a limited scale and fragile, hence it is a challenge to shift from open access to limited access fishery, from unclear to clear user's responsibility. It should be noted that most leading FAD fishers who understand the benefits of the limited access fishery and support it. Strong recommendations also came from participating fishers on the necessity of formal FAD fishery regulation and greater involvement of fishers in the FAD fishery co-management.

###### ***d. Legislation for Co-management***

The co-management approach needs to be backed up by legislation, conferring some rights

and responsibilities for fisheries management to fisher organizations, ensuring the system works properly, and penalizing violators under the law. Moreover, the legal process needs to be started as early as possible, as the finalization process usually requires considerable time. In the case of Dominica, where the legal process began two years ago, legislation is still pending.

#### ***e. Data Collection***

In Dominica, a group of designated fishers did probative data collection on a volunteer basis to provide to data collectors at landing sites. However, this system did not work because 1) the job schedule of data collectors was uncertain such that the volunteer fishers found them difficult to reach and 2) some fishers were reluctant to give information to the designated volunteer fishers because there had been miscommunication in some cases. Generally, the present data collection system is based on the idea that fishers cannot keep records by themselves because they have no interest in data collection. On the other hand, catch and effort data collection from each fishing boat requires man power, but the Fisheries Division has limited manpower and finances. Data collection has therefore taken place through random sampling.

In St. Lucia, FAD monitoring staff and boats were used to collect monitoring data. This method worked for specific data collection during the project period, but may be difficult after the project because of financial constraints.

### **3.4.4.2. FAD Fishery Development and Management**

#### ***a. Process for Implementation of FAD Fishery Management Plan***

In Dominica and St. Lucia, workable ideas for implementation of FAD fishery co-management plan, such as construction, deployment, maintenance, monitoring, licensing (Dominica), regulation, and financial activities, were proposed through discussions at the workshops in the target communities. The original ideas were tested and modified in the course of implementation of the pilot project. This modification process based on a bottom-up approach was important and can serve as a regional model.

#### ***b. Importance of Comprehensive Approach***

In Dominica and St. Lucia, the pilot projects showed that a holistic and comprehensive approach was needed for both FAD fisheries management and DBS fisheries development. It is not enough to cover only specific aspects such as fishing techniques and/or data collection, but many other aspects such as legal, economic, managerial, institutional, and organizational development must also be taken into account.

#### ***c. Financial Sustainability***

Financial support from other sources, such as government or donors, may not be sustainable due to external factors like the global recession and political influence. It would be

better that the FAD management fishery body establishes its financial independence for the sustainable and independent FAD fishery management. In Dominica, the license fee and landing fee collection systems were established. In St. Lucia, there is a plan to collect FAD users' fee from fuel sales through fisher cooperative fuel stations. The establishment of a self-supporting fund generation system is a key to sustainability of any organization.

#### ***d. Importance of Further Technology Development***

The modified FADs, even though the structure and materials were similar in Dominica and St. Lucia, showed superior performance in Dominica. This means the modified FADs' basic design was correct, but minor adjustments in St. Lucia might be required for the buoys on the head parts and sinkers on the mooring rope because of the stronger currents experienced in the area and the thicker mooring rope used there. Many kinds of FAD designs and materials exist, but it is important to utilize locally available materials and local boats as much as possible. The effort to have an effective but economical FAD for sustainable use in the local environment should be continued.

### **3.4.4.3. DBS Fishery Development and Marketing**

#### ***a. Working Group***

In Dominica and St. Lucia, the DBS working group, which comprised of key stakeholders, has promoted DBS fishery development and marketing activities from the initial stages. The working group gave the members an opportunity to think and work together and made clear each member's responsibility. Experiences, knowledge, and skills could be pooled and utilized for the improvement of the activities.

#### ***b. DBS Fishing Ground Development Strategy***

In Dominica and St. Lucia, DBS fishing grounds were found to be close to where the FADs are set with approximately 2,000 m water depth, and at 7–10 NM from the target communities. Therefore fishers in the target communities can easily access and save the fuel cost. Considering operational cost and time requirements, developing the DBS fishing grounds near the target communities is one of the most important factors for the continuation of test fishing and to realize DBS fishing as one of the alternatives for FAD fishers.

#### ***c. Marketing Strategy***

In Dominica and St. Lucia, considering the high quality but limited amount of DBS catch in the initial stages, the marketing strategy was to target tourist restaurants and hotels in niche markets. Squid is not common food in the region, but one of the most popular seafood in the world. DBS is a special kind of squid that has high quality meat. The chefs in the target restaurants and hotels easily understood the value of DBS and thus accepted its high price.

#### **3.4.4.4. Sharing of Information**

##### ***a. Effectiveness of Sharing of Information between Pilot Projects***

Similar pilot projects were implemented in Dominica and St. Lucia and the information and experiences were shared and discussed between the countries. This resulted in accelerated improvements of FAD fishery co-management, technology, and extension methodology in each country.

##### ***b. Textbook***

Textbooks were useful to share information and knowledge among stakeholders at the workshops. The expertise, experience, knowledge of fishers and instructors, and new experiences obtained from the pilot project activities were included in the textbook. However, depending on further technological development, the textbooks may need further modifications in the future.

##### ***c. Local Workshops***

Each workshop gave all the stakeholders many opportunities to discuss and obtain feedback on the progress and results of the activities. As a consequence of monitoring and evaluation, each action plan could be effectively modified with the consensus of all the stakeholders.

##### ***d. Regional Workshops***

Three participants from different countries were invited for the FAD fishery management workshop #1 in Dominica and #2 in St. Lucia. The exchange of information and knowledge among local and regional participants was vital, but the pilot project's follow-up activities for regional participants were insufficient.

Dominica and St. Lucia have advanced knowledge and experience regarding FAD fishery and DBS fishery development. In the regional workshop, Dominica and St. Lucia fisheries and fishers showed readiness and willingness to share their knowledge and experiences with the participants from other countries. Therefore, these participants in Dominica and St. Lucia should be utilized as part of the core group for the follow-up activities with regional participants in the future via the establishment of an appropriate regional working group at CRFM level.

#### **3.4.5. Recommendation for Regional Development**

##### **3.4.5.1. Co-management Approach**

##### ***a. Fundamental Condition and Timing to Start Co- management***

Good linkages between the fisheries division/department and fishers/fishing communities are fundamental for co-management. Both parties' expressing a strong need for each other's inputs may indicate the time is right for starting a co-management approach. Further, if clear and visible benefits can be seen by fishers, not only FADs but also other fishery management

tools such as the maintenance of habitat and nursery ground, MPAs, and other regulations or measures could be better accepted and managed together by fishers and their organizations.

#### ***b. Importance of Awareness Activity***

The importance and benefits of participatory management of the FAD fishery should be impressed upon all stakeholders through a series of meetings, use of the media, posters, pamphlets or newsletters, and fishers' working group discussions. Moreover, it is important to educate consumers on the important role of fisheries co-management to obtain public support. This empowers and gives FAD fishers confidence and pride in collaborating on the participatory management of the FAD fishery.

#### ***c. Importance of Legislation to Back Up Co-management***

The co-management approach may work on voluntary basis, however, the back up by legislation can better ensure its functioning. To extend the co-management approach to other countries, current legislation has to be checked and, where necessary, the process of modification should be started as early as possible. The co-management approach has the potential to bring positive changes to fisheries management in the region and will also require a commitment of fishers to shift from open access to some degree of limited entry.

#### ***d. Objectives of Data Collection***

The objectives of data collection must be clearly understood by all the stakeholders, and it is important to make the data collecting form as simple as possible in order to achieve the target objectives. Sustainability has to be a priority. To encourage fishers to share data, clear and visible benefits of providing data should be shown to them. It is, therefore, indispensable to demonstrate the use of data for management planning and decision-making and to provide feedback to fishers regularly.

In Dominica, it would be better to gather data from specific groups such as fishers who bought FAD fishing licenses. The provision of data must be defined as part of their responsibility associated with the right to fish and have a license. It is recommended that the provision of data from fishers as well as necessary resource management measures should be clearly defined in government regulations or by-laws of the cooperatives.

#### ***e. Data Collection and Provision by Logbook***

In Dominica, once approved by the Fisheries Division, fishers' logbooks are used for obtaining bank loans. This is an example of a clear and visible benefit to fishers from providing data.

Data collection by fishers themselves is an essential part of their small-scale business management. Currently, only a very limited number of fishers who have a high degree of awareness are keeping records of their fishing activities. Further efforts to increase awareness of

the importance of recordkeeping, including bookkeeping, is necessary for fishers to be motivated to collect the data on their own initiative. This does not preclude the requirement of the fisheries divisions' data collection. Use of both methods for collecting data will improve the present data collection system.

#### ***f. Biological Data Collection of Target Species***

Catch and effort trends from the FAD fishery and the size trends of target species should be analyzed with a view to achieve sustainable and profitable resource utilization. However, biological data collection necessary to analyze the size trends is not part of data collectors' routine work in Dominica and St. Lucia. Consequently, biological data collection of target species, i.e., dolphin fish and yellowfin tuna in the case of ocean pelagic species, should be continued at the selected landing sites, such as at Soufriere and Vieux Fort in St. Lucia and Mahaut in Dominica, where the data collectors enjoy good cooperation from the fishers. A minimum number of samples (50/month) should be maintained and sustainability of biological data collection should be prioritized. It should be continued in the medium term. In addition, biological data collection for the main target reef and coastal demersal species and coastal pelagic species should be considered as well.

#### **3.4.5.2. FAD Fisheries Development and Management**

##### ***a. Process for Implementation of FAD Fishery Co-management Plan***

FAD fishery co-management ideas that work in Dominica and St. Lucia should be utilized in other countries in the region that have similar fisheries structure and keen interest in utilizing FADs for pelagic fishery management. For FAD fishing to be introduced successfully in the beneficiary countries, however, well-customized, detailed, and comprehensive FAD management plans should be made and be modified depending on the practical situation in each country.

##### ***b. Organizational Development through Financial Sustainability***

A strong and sustainable organization needs sound and reliable sources of income to finance its activities. Fisher organizations should plan their activities in a way that the source of financing comes from within the fisheries sector, i.e., the social infrastructure and economic development of the sector should be driven by the economic viability of the fishery resource. Further, fishers contributing to the organization should clearly see and understand the benefits of their contribution. Development plans should carefully take into account the activities' financial sustainability.

##### ***c. Technology Development***

Although the newly introduced, modified FAD showed superior performance in Dominica, research should be continued for further technological improvements, such as for the minimization of FAD submersion and loss and maximization of operation days, taking into

account cost performance.

The body responsible for FAD fishery management should set up technological standards for safe, efficient, and economical construction and deployment of FADs, taking into consideration the experience of fishers in operating the traditional FAD. Regular maintenance is the key to improving FAD durability; therefore, fishers should consider checking the FAD on daily basis and the management body should consider more detailed checking on monthly basis.

### **3.4.5.3. DBS Fishery Development and Marketing**

#### ***a. Working Group***

A working group comprising of key stakeholders should be established with the launching of new challenges such as DBS fishery development and marketing activities. Collaboration within a working group enhances the co-management spirit among the members. Further, members of the working group would constitute a pool of human resources with the necessary expertise, experiences, knowledge, and skills to achieve the desired objectives.

#### ***b. Marketing Strategy***

In order to develop unutilized resources such as DBS, marketing strategies must be carefully selected according with the resource's characteristics and real value, and the market environment in the region. Marketing opportunities within the region should also be explored.

### **3.4.5.4. Sharing of Information**

#### ***a. Workshop***

The sharing of information, knowledge, progress, results, and lessons learned from activities are in itself an incentive for stakeholders to cooperate with each other in the future. Therefore, opportunities for the sharing of information should be given on regular basis through workshops and meetings.

#### ***b. Regional Cooperation***

The expertise available in the national fisheries department and the fisher folk organizations in each country, as well as in CRFM, CNFO (Caribbean Network of Fisherfolk Organizations), UWI, CFTDI, and other regional and national institutions should be jointly utilized for enhancing intra-regional cooperation, and the provision of extension services and technical assistance to the CARICOM member countries. Moreover, useful human resources and programs in each country should be surveyed and utilized for the CARICOM member countries. Coordination should be one of the important roles of CRFM in enhancing or establishing working groups.

### 3.5. Pilot Project on Fisheries Statistical System in Guyana and St. Vincent and the Grenadines

#### 3.5.1. Background of the Project

In the first year of the study for the fishery statistical systems, the CARICOM member countries were assessed, and then categorized into the three groups presented in Table 3-6.

**Table 3-6: Groups Categorized on Fishery Statistical Systems of the CARICOM Member Countries**

Characteristic of the Groups	CARICOM Member Countries	Selected Country for the Pilot Project and its Profile
<b>Group A:</b> Group having developed their own FSS model using existing resources.	Trinidad and Tobago, Barbados, Jamaica, Antigua and Barbuda,	None
<b>Group B:</b> Group required developing the FSS model in the first stage	Belize, St. Kitts and Navis, Grenada, St. Lucia, St. Vincent and the Grenadines, and Dominica	<b>St. Vincent and the Grenadines</b> <b>Period:</b> Aug. 2010 - Sept. 2011 <b>Stakeholders:</b> Fisheries Division, Fishery Cooperatives
<b>Group C:</b> Group confronting a lot of difficulties more than its own maximum effort	Suriname, Guyana, Haiti	<b>Guyana</b> <b>Period:</b> Sept. 2010 - Sept. 2011 <b>Stakeholders:</b> Fisheries Department, Fishery Cooperatives, Industrial Fishery

St. Vincent and the Grenadines (SVG) and Guyana were selected as the pilot project sites for the proposed Fishery Statistical Systems model for the CARICOM member countries categorized as group B and group C in the baseline study.

**Table 3-7: Summary of Size of Fishing Operation and Number of Fisheries Officers Involved in Fisheries Statistical System**

	Guyana*	SVG**
<b>Fishery Scale (Difficulties and Complexities on Fishery Data Collection)</b>		
Coastal Area (km)	459	124
# of Landing Site	148 sites	32 sites
# of active boat	1,234 vessels	486 vessels
<b>Existing Human Resource</b>		
# of Fishery Officer (HQ)	8	10
# of Data Collector	1***	4
# of Extension Officer	6	6

\* The scale of Guyana's fishing operation is four times that of SVG (CARICOM member countries average)

\*\* SVG is most likely the average of the fishery scale among the CARICOM member countries

\*\*\* The fishery officers in HQ and regional offices are also charged with the collection of fishery data



The coverage of the current data sampling program in Guyana is 0% – 5%<sup>13</sup> for gear and vessel types, while the coverage of the current data sampling program in St. Vincent and the Grenadines is 10% – 100%<sup>14</sup> at the landing sites. That means Guyana has a great deal of difficulty covering its landing sites and obtaining enough samples, while St. Vincent and the Grenadines already covers most of the landing sites and obtains enough samples using its existing resources.

### 3.5.2. Purpose of the Pilot Project

The pilot project’s aim is to study the following issues:

- How the needs-oriented fishery data collection can be realized under the given conditions
- How the fishery statistical data management can be improved under the given conditions
- How the relevant fishery organizations and corporations can be involved to enhance the implementation of the collaborative fishery data collection mechanism

The pilot project’s expected outputs for the selected member countries, Guyana and St. Vincent and the Grenadines, were set to correspond to the actual situation of the fisheries statistical systems. The expected outputs of the pilot project in each country are shown in Table 3-8.

**Table 3-8: Identified Expected Outputs in the Pilot Project in Guyana and St. Vincent and the Grenadines**

<b>Pilot Project on Fishery Statistical Systems in Guyana</b>	
Output 1	An improved fishery statistical data collection system to meet fishery management objectives under given conditions in Guyana
Output 2	A refined sustainable fishery data collection framework through a collaborative mechanism involving both the industrial fishery and small-scale fishery organizations
Output 3	An improved fishery statistical data management under the given conditions in the Fisheries Department
Output 4	An improved fishery statistical data analysis and reporting process to support decision making in fishery management in a timely manner under the given conditions in the Fisheries Department
<b>Pilot Project on Fishery Statistical Systems in St. Vincent and the Grenadines</b>	
Output 1	Improved fishery statistical data collection systems to meet fishery management objectives under the given condition in St. Vincent and the Grenadines
Output 2	Improved fishery statistical data management under the given conditions in the Fisheries Divisions
Output 3	Enhanced fishery statistical information dissemination among the relevant fishery organizations

<sup>13</sup> The coverage of each gear and vessel type is as follows: Gillnet 7’-8’ mesh size: 5.1%, Gillnet 5’-6’ mesh size: 1.1%, Gillnet 2’-4’: 0.2%; Pin Seine: 0.0%, Chinese Seine: 0.3%, Others: 0.0% in 2010.

<sup>14</sup> The coverage of Kingstown fish market is 100%. The coverage of the local landing sites is as follows: the primary stratified landing site: 25%, the secondary stratified landing site: 20%, the tertiary stratified site: 10%, in 2010.

### 3.5.3. Activities and Achievement

#### 3.5.3.1. Guyana

##### a. Activities and Achievements on Output 1

The Fisheries Department, using its own resources, completed a vessel count survey, which became available in August 2011. Table 3-9 shows the result. The data are being analyzed at this moment in order to update the fishery data sampling program and schedule.

**Table 3-9: Updated Vessel Count in Guyana (August 2011)**

	GNP <b>in</b>	GNP <b>cc</b>	GNN	C/S	P/S	Tie	Cad	Total
	7-8'	5-6'	2-4'					
Region # 1	0	0	15	0	0	0	15	30
Region # 2	5	15	61	29	2	1	6	119
Region # 3	0	27	43	111	1	5	22	209
Region # 4	59	99	144	89	2	0	37	430
Region # 5	0	55	78	35	3	0	7	178
Region # 6	0	100	107	43	18	0	0	268
<b>Total</b>	<b>64</b>	<b>296</b>	<b>448</b>	<b>307</b>	<b>26</b>	<b>6</b>	<b>87</b>	<b>1234</b>

Although its sample size is small, catch and effort data was regularly collected by fishery officers and part-time data collectors in Regions 2, 3, 4, 5, and 6 during the pilot project. However, data collection may not continue without sufficient budget support and adequate logistical support for the transportation of the data collectors, with the exception of the fishery data collection in Region 4, where a part-time data collector is stationed (Table 3-10).

**Table 3-10: Updated Data Sampling Program in Guyana**

	GNP <b>in</b>	GNP <b>cc</b>	GNN	Chinese Seine	P/S
	7-8'	5-6'	2-4'		
<b>Sample Size / Month</b>	8	30	42	46	4

##### **Implementation Structure**

Region 2 R officers	0	0	6 (R2)	12 (R2)	0
Big Bird & Son (log)	2 (R2)	4 (R2)	6 (R2)	0	0
Part time collector 1	6 (R4)	6 (R4)	10 (R4)	4 (R4)	0
Part time collector 2	0	0	4 (R3)	16 (R3,4)	0
Part time collector 3	0	4 (R5)	6 (R5)	6 (R4)	0
Fishery Officer HQ	BDC & Monitoring of Data Sampling				
Region 5/6 R officers	0	0	10 (R6)	8 (R5)	
#66 FC (log)		16 (R6)			4 (R6)
Data Supervisor	On the JOB training / Inspection / Supervision of the collected data				
Data Operators (3)	Total 130 samples, Input 40 – 45 samples for each				

Under the guidance and leadership of a local consultant hired by the pilot project, the BDC program of the Fisheries Department was reviewed and recommendations made with regards to the sample sizes. As the staff of the Fisheries Department continues to gain experience in data collection and dealing with the fishers and the market situation, the data sampling activities will become smoother.

#### ***b. Activities and Achievements on Output 2***

The sensitization workshops had active participation by all those attending. A problem tree and a fishing calendar were produced as a result of the workshops for each landing site. Although all the cooperatives at landing sites showed willingness to participate, only one cooperative (#66 in Region 6) and one firm (Big Bird & Son in Region 2) among them participated in logbook data collection. The logbooks were distributed to them. The logbook data are expected to supplement the data currently collected by the Fisheries Department using the trip interview method. The number of fishers who regularly participated in this activity was about 20 to 30. Staff members of the Fisheries Department were involved in both the workshop and logbook activities.

Biological data sampling of the industrial fishery, for collecting catch data of the last haul of shrimp/seabob (small shrimp species, *Xiphopenaeus kroyeri*), was planned and details were discussed regarding the type of information to be obtained from this exercise. However, the sampling was cancelled due to a number of considerations that surfaced during the discussion.

#### ***c. Activities and Achievements on Output 3***

The current work flow and the fishery statistical data management flow were reviewed, and a proposal made for properly securing the collected fishery forms and inputting data in a timely manner. This proposal was under development as of September 15, 2011. A computer network including a printer and an external hard network drive containing the fishery data shared among the fishery officers has been installed in the Fisheries Department. The network will be the platform for the electronic fishery data pertaining to the fishery statistical data management flow. Furthermore, a filing system using folders and a filing cabinet has been introduced for properly securing the fishery data forms. All processes required for the fishery statistical data management flow were documented and visualized so that fisheries staff members are able to follow those tasks in cases where the statistical officers are absent.

#### ***d. Activities and Achievements on Output 4***

A minimum for fishery data analysis was defined and acknowledged among the fishery officers. The data analysis is designed to recognize the CPUE by each of the fishing gear types such as Chinese seine, Pin seine, Gill net (mesh size 2 – 4 inches), Gill net (5 – 6 inches), and Gill net (7 – 8 inches) for each main species and to estimate total catch of each of the main species at the landing site using days of fishing for each of the fishing gear types and number of

vessels with each of the fishing gear types. The procedures for the fishery analysis have been documented and tools for the data analysis using MS Excel have been developed.

In Guyana, small-scale fisheries statistical data is being reported and CPUE by each of the fishing gear types is being collected and estimated in a limited manner. The minimum requirements to meet the fishery management objectives are the filing of reports of the estimated CPUE according to the fishing gear types for the main species, which are commercially important, and of the total catch at the landing site. The processes for reporting the analyzed fishery data were reviewed and proposals made with a view to achieving the minimum requirements for meeting the fishery management objectives during the pilot project period.

After the biological data sampling trial, the length-weight relationship as well as length-frequency distribution of the fish caught by each fishing method was analyzed. Staff members of the Fisheries Department participated in the planning process and in the modification and final analysis of the data. As a consequence, after obtaining sufficient information on length-weight relationships, the data collection shifted its emphasis to obtaining unbiased length measurement data.

### 3.5.3.2. St. Vincent and the Grenadines

#### *a. Activities and Achievements on Output 1*

The fishery data sampling program was updated to analyze the sampled catch data for 2010 and 2011. The summary of the data sampling program is presented in Table 3-11.

**Table 3-11: Updated Data Sampling Program in St. Vincent and the Grenadines**

	KFM	Zone 1	Zone 3	Zone 5	Zone 2 Barrouallie
<b>Sample Size / Month</b>	200-300	15-30	10-20	15-30	3-6
<b>Implementation Structure</b>					
Data Collector (Zone 1)	Monitoring BDC	Sampling	---	---	---
Data Collector (Zone 3)	---	---	Sampling	---	Monitoring BDC/CPUE
Data Collector (Zone 5)	---	---	---	Sampling BDC	---
Barrouallie FC	---	---	---	---	Monitoring CPUE
Data Collector (Zone 2) if possible	---	---	---	---	Sampling BDC/CPUE
Data Supervisor / Database Manager	SFA (1)				
Data Operators (2)	Total 245 - 390 samples, Input 125 – 150 samples for each				

The fishery data collection forms were revised and used to verify if they could be adapted for practical and sustainable use. New data items have been added for this revision, including catch by species for the second fishing gear type, FAD fishing as a fishing gear type, and list of the registered vessels in each of the sampling sites. An examination of the forms used for the collected fishery data reveal that at no time were two or more fishing gear types used on the same fishing trip during the pilot project.

The list of the registered vessels on the data sampling forms may help the data collectors to identify each registered boat if it still exists, and if it is currently active and fishing. They may then avoid missing a fishing boat at the moment of sampling, and be better able to update the actual fishing situation at the sampling site.

A fishery data collection workshop at the Kingstown fish market was held for three assistants from the Kingstown fishery cooperative. This is expected to strengthen the fishery data collection at the Kingstown fish market, in order to obtain more accurate classification of fisheries data with the proper names of species. However, difficulties were encountered in collecting the fishery data from fishers where many landings are used at the same time. Furthermore, it is too difficult to take the data for items by “Gear Type.”

The fishery biological data form was modified and tested to verify that the revised forms could be adapted for practical and sustainable use, and that data items on the form could be used for coastal resource management, especially for FAD fishing and bottom fishes. The same form as that used for the pilot project in St. Lucia was introduced. The form can be standardized among the CARICOM member countries adopting FAD fishing.

The Barrouallie Fisheries Cooperative and the Fisheries Department were aware of the importance of strengthening their cooperative relationship, and the following support activities served to improve collaboration somewhat between them. The proposed fishery data collection was conducted for one month, but it was observed that the fishery cooperative may not be able to follow through as necessary on the proposed fishery data collection. Among the many difficulties the fishery cooperative faced in realizing the proposed fishery data collection were inadequate staffs and lack of a cooperative relationship with the fishers during the pilot project. The proposed fishery data collection was revised so that the landing activity was assessed using data items: a) average times a vessel went fishing, b) number of active boats, and c) percentage of landings at the Barrouallie landing site.

#### ***b. Activities and Achievements on Output 2***

The CARIFIS application has been installed on the computers at the Fisheries Division, and fishery data such as catch and effort and vessel registration data have been migrated successfully from their legacy database, in collaboration with a local consultant who is familiar with the CARIFIS database. The CARIFIS database is operating properly and gives evidence of efficient and effective fishery data management. CARIFIS has also been successfully installed

and is operating in the Fisheries Divisions in St. Lucia.

CARIFIS training was conducted by a CRFM officer and the local consultant, especially on how to register the vessel information, input catch and effort and fishery biological data, and create queries and reports from the input fishery data as needed by the CARIFIS database operator. The Fishery Divisions database managers and operators are qualified to operate the CARIFIS database due to the CARIFIS training. This proved that it is possible for any fishery agency in any CARICOM member country to deal with their fishery data using the CARIFIS database.

Although CARIFIS is a powerful database application for fishery data management, it is not compatible with Windows Vista, Windows 7, or later versions of Windows OS. A trial reconciliation of CARIFIS executable files with the latest version of the database platform (Visual FoxPro 9.0) on Windows 7 was carried out; however, it was not successfully completed. The source code written in Delphi computer language is not commonly used among the CARICOM member countries and will need to be modified. The limited time allocated for the pilot project may not allow the issue to be remedied with the existing resources.

### ***c. Activities and Achievements on Output 3***

Fishery data dissemination and awareness activities were carried out for the fishery cooperatives and elementary school. These kinds of activities, however, should be maintained for a long period to see the impact of the activities.

A fishery statistical data meeting was held on October 11, 2011, to share the lessons learned and findings gained during the pilot project, and to recommend fishery statistical systems including the fishery data sampling program, data management, data analysis, fishery data feedback, and implementation structure and processes.

#### **3.5.4. Lessons Learned**

##### **3.5.4.1. Guyana**

It is crucial to put transportation in place to allow for the fishery data sampling to go ahead as planned.

Both Chinese seine and pin seine are operated daily, sometimes twice a day depending on the tidal situation. Collection of catch and effort data from Chinese seine and pin seine is difficult due to irregular operating times and each operation's rather small-scale landing site. It is reasonable to assign some fishers the task of reporting their catch rather than assigning staff of the Fisheries Department to collect data at the landing sites.

A fuel tax exemption for fishing purposes, the creation of a social safety net, and tax benefits for fishing gear and engines may all be good incentives in exchange for registration and catch reports.

About 10–15 years ago, fishery cooperative facilities were constructed, using funding from the Canadian International Cooperation Agency (CIDA), in cooperation with the Fisheries Department. One of the fisheries cooperatives participated in the logbook program. Moreover, the only firm participating in the logbook program was supported in the construction of its facilities by the Fisheries Department about 15 years ago. A point in common shared by the participating fisheries cooperative and the firm is that they have good leadership and stable businesses, and a good relationship with the Fisheries Department. Whether fishery cooperatives and firms can be involved in the fishery data sampling program depends on the presence of leadership, good business management, and trust between fishers and the Fisheries Department. It was found that fishers who belonged to a well-managed cooperative understood the importance of collaborative work. Enhanced fisheries cooperatives are a key factor in improving fishers' activities.

The other fisheries cooperatives in Regions 3, 4, and 5 did not participate in the logbook program. It appears that there are management and leadership problems. Urbanization may be a cause of the low interest shown in the governance of the fishery sector, as well as in community-based cooperative fisheries management.

Considering the challenges faced by the Fisheries Department, it is prudent to conduct fisheries statistics data collection in collaboration with the private sector. The key in this collaboration or co-management is continuous communication and exchange of information, as well as the establishment of a trusting relationship. Strengthening cooperative activities such as the joint purchase of fishing gear, fuel, and other equipment, or joint marketing are essential. In order to achieve this, regular visits to landing sites by fisheries staff is vital. Catch and effort data collection and sharing the analyzed data with fishers are critical. In addition, strengthening of fisheries cooperatives through consultation and training will enhance the co-management process.

Fisheries statistical data need to be obtained from various sources as demonstrated during the pilot project. Continued data collection through routine catch and effort data collection, logbook data with collaborative fishers, and landing site management are necessary.

The major fishing method used in Guyana now is with the large mesh size gill net (mesh size of 5–8 inches), which is out to sea for 10 to 14 days per trip. Fishers use ice and gut the fish to maintain the quality of fish to be exported. It is easier to obtain data on the amount of catch and effort for this fishery. It should be noted that, as reported through conversations with fishers, the length of nets has almost doubled in the last ten years. Therefore, the fishing effort would appear to have been doubled, but the catch amount has not increased for targeted species such as gray snapper and sea trout. The industrial fishers are willing to collaborate with the Fisheries Department to manage and utilize the resources sustainably. Their target species of shrimp and seabob are also sought after by gray snapper and sea trout, which feed on them. There is competition between human and fish for consumption of the shrimps.

The catch data collection on the last haul of shrimp/seabob could only be realized by placing someone on the vessel to collect data. The fishing company agreed, but the cost of employing someone could not be accommodated in the present project.

Trawlers' by-catch data are important for both industrial and small-scale fisheries. Logbook data from the industry are useful but incomplete, since less valued fish and juveniles are discarded. Since the onboard observer option is costly and the safety of the observer may not be guaranteed, the last haul survey could be seen as a good alternative.

The next step in biological data collection is to assess the age and maturity of economically important species. This information helps to determine capture size limitations or closed seasons and areas to ensure sustainable reproduction.

Fisheries resource management requires that all these competing interests be taken into consideration to balance the use of the resources ecologically and sustainably. The Fisheries Department's responsibility and tasks are important, although it has limited human and financial capacity for fisheries statistics in particular and fisheries resource management as a whole.

Skills and knowledge pertaining to the proposed fishery statistical data management flow should continually be strengthened, to enhance awareness of the importance of managing fishery data in a timely manner.

It is crucial for the Fisheries Department to document and visualize all the procedures involved in each of the processes for the fishery statistical systems. These procedures will be used when updating the fishery data sampling program and improving the current fishery statistical systems. Moreover, it may help the Fisheries Department in following the tasks in the case where the fishery statistics senior officer is absent.

The policy on fishery data analysis and reporting has been frequently changed; moreover, sometimes the fishery statistical data have not been treated as important, especially for coastal small-scale fisheries. It is crucial that responsible persons in the Fisheries Department recognize the importance of fishery data collection and its analysis, and follow the fishery policy determined by the Fisheries Department in Guyana.

Regarding the issues of poor registration and licensing, the Fisheries Department needs to take a stronger position on enforcement. Unregistered fishers are illegal. The purpose is not to collect taxes or user fees but to obtain reliable and up-to-date records of fishing activities. Fishers should be informed that a limit on entry into small-scale fishery may be imposed in the future.

It is recommended that the level of the fishery statistical systems be categorized according to the budget amount. This proposal needs to contain, for each of the levels of the fishery statistical systems, the required input and its effect with respect to coastal resource management and socioeconomic factors in the fishery communities.



#### **3.5.4.2. St. Vincent and the Grenadines**

It was found that the manager of the fish market and/or president of the fisheries cooperative was the key stakeholder in obtaining collaborative relationships on fishery data collection. It is extremely important to maintain good relationships with and support the key stakeholders for any fishery activities. It is probably a good idea to have regular meetings with the key stakeholders to discuss any issue encountered by either the key stakeholders or the Fisheries Division, so as to maintain a sustainable fishery data collection mechanism involving these key stakeholders. Moreover, it was also found that a well-managed fishery cooperative whose business is stable tends to be very collaborative with the Fisheries Division, so enhancement of fishery cooperative management is a key factor in improving fisheries data collection systems.

The Fisheries Division's management and commitment for any task are important, although it has limited human and financial capacity for fisheries statistics in particular and fisheries resource management as a whole.

There are various sources for obtaining the fishery data, such as a census at the Kingstown fish market, sampling from the trip by the fishery data collector, and the Barrouallie Fisheries Cooperative. These existing fishery data sources should be kept in good condition; moreover, the data collectors can be arranged according to the updated stratification of the landing sites in St. Vincent and the Grenadines.

The Calliaqua Fisheries Cooperative provided the Fisheries Division with fishery data collected from the landing toll receipts (census) when it was operating and its business was stable. However, in 2010 the operations at the Calliaqua Fisheries center ceased, and the Fisheries Division had to rely on the sample data collected by the Fisheries Data Collector who visited the site four or five times per month. It is crucial that the Fisheries Division support and collaborate with the fisheries cooperatives as well as maintain a good working relationship with them so that they would be able to manage the centers properly hence, providing the fisheries division with quality data.

Strengthening of fisheries cooperatives through consultation, training, and technical support corresponding to the needs identified by the fishery cooperatives will also enhance co-management.

It may take a long time to develop a good enough cooperative relationship with the fishers in order to obtain the fishery data, and the Fisheries Divisions will be expected to support the gasoline business, as an incentive to improve the cooperative relationship with them.

During the pilot project period some fisheries centers were not operational because of the lack of proper management of the business and facilities by the cooperatives. It is therefore recommended that the Fisheries Division in collaboration with the co-operative department assist the Fisheries cooperatives in improving their management skills, which will better equip

them to manage the business and facilities. In exchange for business and facility management support they will then be obligated to provide the fisheries Division with the fishery data.

Logistic arrangements with the Maritime Authorities and the Ministry of Telecommunications had to be worked out before the inspection of fishing boats and updating the data could be carried out. In addition, staff obligations and time schedules caused further delay in the start of the vessel inspection activity. It should be noted that steps taken for vessel inspection such as arrangements with the relevant stakeholders, public announcements and education, workshops with fishermen and the fishing boat inspection sites should be identified and their cost and time estimated.

The biological data collection two or three times a month for main species as well as CPUE for each of the available fishing gear types, such as Fish Pot and Trolling, needs to be conducted while considering reallocation of the existing resources. The data collection needs to be conducted at the Kingstown, Owia, and Barrouallie landing sites by the data collectors in cooperation with the fisheries cooperatives. The data collectors will require training for the biological data collection.

At the Kingstown fish market, the fishery data collection needs to be inspected once a week, with a data collector allocated from zone 1, in order to strengthen the fishery data collection to achieve a more accurate understanding of the situation of the fishery activities.

The stratification should be updated using updated fishing boat registration in accordance with the proposed procedures to determine the stratification of the landing sites in St. Vincent and the Grenadines.

The CARIFIS application and database cannot be introduced to the fishery officers by inviting them to a certain country for training together. The CARIFIS training needs to be conducted at the Fishery Divisions or Department office in each of the CARIFIS member countries with the installation of the CARIFIS application and migration of the fishery data into the CARIFIS database from the legacy database. It would be ideal if the CARIFIS or other database program would provide the feature of printing the sampling forms listing the registered vessel information. The CARIFIS application was developed using a computer language (Delphi) that is not commonly used among the CARICOM member countries; moreover, the database platform (FoxPro 6.0) used for the CARIFIS database had not been used for the past few years. The latest version of the database platform was released five years ago, and Microsoft will stop technical support for it within three years. It may be difficult to find computer programmers capable of dealing with technical support issues in the CARICOM member countries. The CARIFIS application and database needed to be developed using a popular computer language, such as Visual Basic or JAVA, and a popular database platform such as MS Access or My SQL. Using an uncommon computer language and database platform may cause many difficulties in maintaining and updating the computer program and database

platform. It should be noted that it would be better to make use of local consultants familiar with the CARIFIS application and database, and human resources qualified to operate them in the Fisheries Divisions without any additional computer training in order to install and operate the CARIFIS application and database, where the procedures for the fishery data management are already established. Any computerization of the fishery data management can be carried out for the established procedures.

Fisheries Divisions should use the CARIFIS application and database for the census fishery data and collected fishery biological data as well as sampled catch and effort. It may be better to store several data sources in the same database. Procedures for updating the master table data should be documented, such as the landing site table and registration and operation vessel data table, in the case where the fishery data manager in St. Vincent and the Grenadines is absent.

Some of the materials for the dissemination and awareness activities were already developed, and some fishery officers already recognized the importance of dissemination of the collected fishery data to enable fishers to be aware of the need to obtain the fishery statistical data for appropriate coastal resource management. It is important to make use of the existing materials and resources for the fishery data dissemination activities.

It seems that using the collected fishery data for the dissemination and awareness activities related to the enhancement of coastal resource management serves to impress people with the actual situation of the fishery sector.

It usually takes a long time to see the impacts of the dissemination and awareness activities in terms of the coastal resource management, especially awareness activities in a school. This should be taken into account with any dissemination and awareness program.

It is recommended that the level of the fishery statistical systems be categorized in accordance with the budget amount. Several categorized levels of the fishery statistical systems will be proposed for the budget's application. This proposal should contain, for each of the levels of the fishery statistical systems, required input and its effect in relation to aspects of coastal resource management and socioeconomic factors in the fishery communities.

It is crucial for the Fisheries Divisions to document and visualize all the processes of the fishery statistical systems. These will be used to update the fishery data sampling program and improve the current fishery statistical systems. Moreover, it may help the Fisheries Divisions fishery officers to carry out the tasks for the fishery statistical systems in the case where the fishery statistics senior officer is absent.

### **3.5.5. Recommendation for Regional Development**

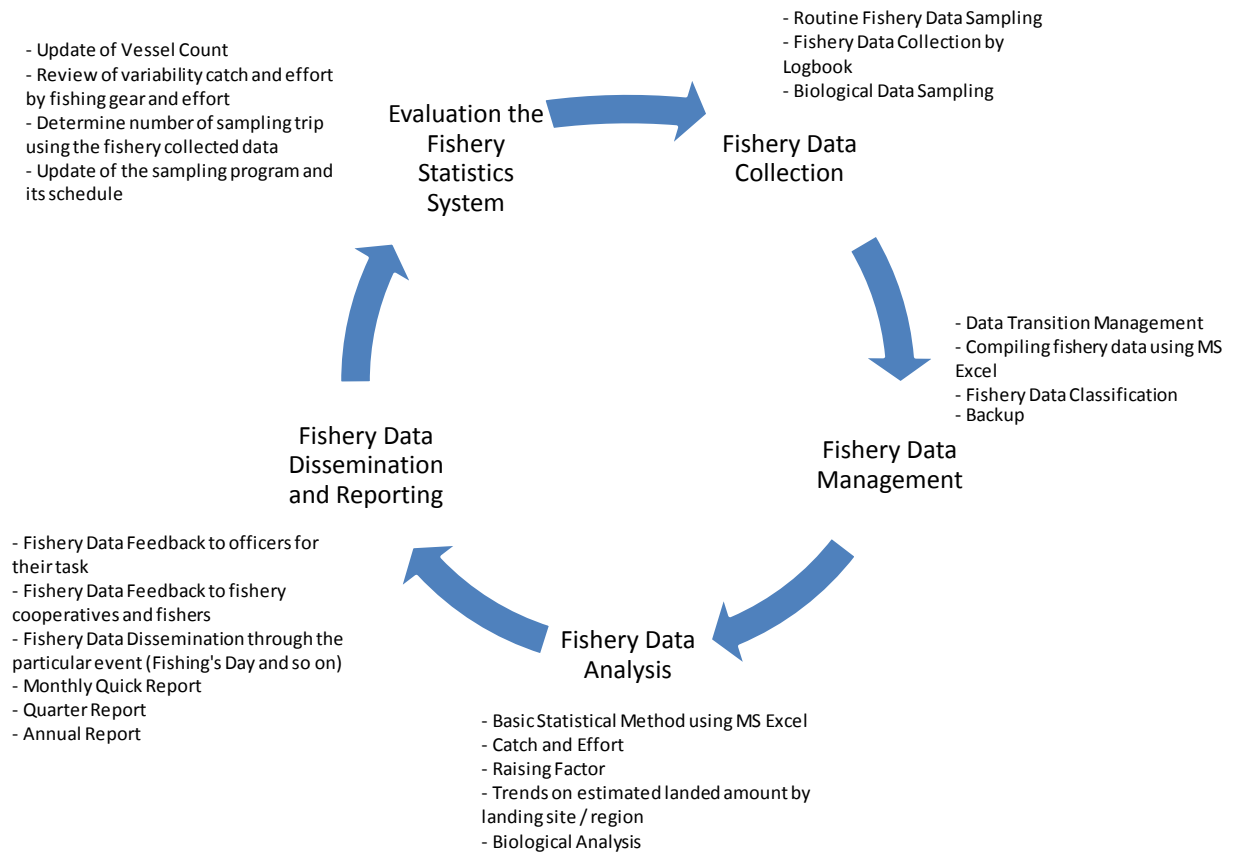
The project intends to categorize the CARICOM member countries into three groups (A, B and C), since different system designs and steps for improving the fisheries statistical systems may be required for each group. Table 3-12 shows the summary of proposed fishery statistical

system profiles for each group.

**Table 3-12: Summary of Fishery Statistical System Profile for Each Group**

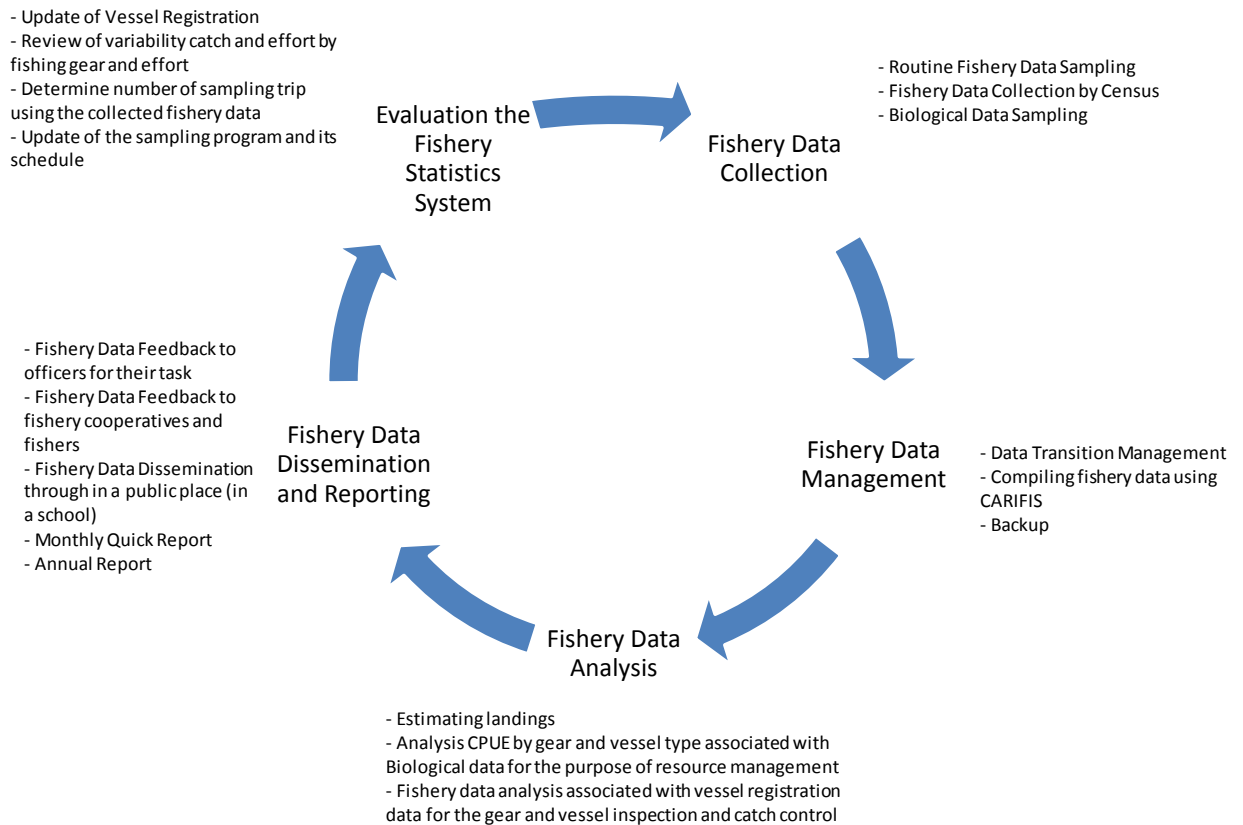
	<b>Data Sampling</b>	<b>Data Management</b>	<b>Expected Impact</b>
<b>Group C</b> <i>Guyana</i>  <b>Level 1</b>	<ul style="list-style-type: none"> <li>▪ Regular Sampling but the number of sampling less than 10% of possible sampling</li> <li>▪ Occasionally, BDC is conducted</li> <li>▪ Vessel registration isn't updated</li> </ul>	<ul style="list-style-type: none"> <li>▪ Data Platform is MS Excel spread sheet since absence of data manager</li> <li>▪ All procedures are documented</li> <li>▪ All procedures in place and time</li> </ul>	<ul style="list-style-type: none"> <li>▪ To grasp basic fishery information (CPUE, Landing) in a timely manner</li> <li>▪ To estimate trend of CPUE each of main species</li> </ul>
<b>Group B</b> <i>SVG</i>  <b>Level 2</b>	<ul style="list-style-type: none"> <li>▪ Frequent data sampling, more than 10% of possible sampling:</li> <li>▪ Regularly, BDC is conducted</li> <li>▪ Vessel registration is updated regularly</li> </ul>	<ul style="list-style-type: none"> <li>▪ In addition to above,</li> <li>▪ data Platform is database application (CARIFIS)</li> <li>▪ Catch data is associated with the vessel registration</li> </ul>	<ul style="list-style-type: none"> <li>▪ To enable the systems to be effective and secured</li> <li>▪ To assess trend of CPUE associated with biological data for resource management</li> </ul>
<b>Group A</b> <i>T.T</i>  <b>Level 3</b>	<ul style="list-style-type: none"> <li>▪ Census in the main landing sites in cooperation with fishery cooperatives, firms</li> <li>▪ Frequently, BDC is conducted, and it is associated with CPUE data</li> <li>▪ Vessel registration is updated and under control</li> </ul>	<ul style="list-style-type: none"> <li>▪ In addition to above,</li> <li>▪ Data analysis tools are introduced</li> <li>▪ Stock assessment tools are introduced</li> </ul>	<ul style="list-style-type: none"> <li>▪ To enable fishery officer to analyze the collected fishery data with several methods for the stock assessment</li> <li>▪ To enable fisheries department to formulate fishery management plan for sustainable use of fisheries resources</li> </ul>

It is recommended that the CARICOM member countries be classified into the abovementioned levels of the fisheries statistical system, taking into consideration the management objective and needs of their fishery policy and plan as expressed under “Expected Impact” in the table above. Additionally, it should also be verified if they are able to conduct “data sampling” and “data management” using their existing resources. Having identified their level for the fishery statistical system, the actions to be taken in regard to the fishery statistical system cycle should be identified and defined for the CARICOM member countries. The following figures are presented for Guyana and St. Vincent and the Grenadines, which belong to Group C and B, respectively.



**Figure 3-1: Actions in Each Process of Fishery Statistical System Cycle for Guyana (Group C)**

The key concept for the proposed fishery statistical systems for Guyana is that “the fisheries statistical data should be in place and timely.” The following recommendations should be considered for Guyana’s fishery statistical systems. A key to collaboration or co-management is the continuous communication and exchange of information and establishment of a trusting relationship. Regular visits to landing sites by fisheries staff are very important. Catch and effort data collection and its feedback after analyzing the data will be a good opportunity. It is crucial for the Fisheries Department to document and visualize all the processes of the fishery statistical systems, which will help the Fisheries Department to provide new staffs with the necessary training to maintain the fishery statistical systems.



**Figure 3-2: Actions in Each Process of Fishery Statistical System Cycle for SVG (Group B)**

The key concept for St. Vincent and the Grenadines’ proposed fishery statistical systems is that “the fishery statistical systems should be improved with updated fishery information and adequate allocation of existing human resources in collaboration with fishery cooperatives and fishermen.” The following recommendations should be taken into account for St. Vincent and the Grenadines’ fishery statistical systems.

It is recommended that vessel registration and stratification of the landing sites be updated every year; this should be taken into account when updating the data sampling program for the next year. Days of sampling should correspond to the level of the stratification. That means that a record of the days of sampling at a landing site should be kept for a year, and reviewed at the end of every year. Fishery data management should be enhanced using the CARIFIS database. All input catch data should be associated with the registered boat in the CARIFIS database. If the CPUE and biological data could be associated with gear type, especially for FAD fishing, they can be used for control of the gear type and/or FAD for the purpose of sustainable resource management. A key to collaboration or co-management is continuous communication and exchange of information and the establishment of a trusting relationship. In conclusion, the fishery statistical system consists of several processes, and these processes are cycled in order. As the cycle is repeated, the fishery statistical system can be incrementally improved.

The following recommendations are points in common to all the groups.

It is strongly recommended that the facilities be renovated and marketing activity be organized appropriately. The fish sales areas for wholesale and retail need to be separated and the selling period set appropriately to encourage more wholesalers and retailers to buy fish. All the fish should be weighed when landed before being displayed for sale to buyers. Another key factor is strengthening cooperative activities such as joint purchases of fishing gear, fuel, and other equipment.

Considering the limited human resources and budget of the fisheries division or department, it is indispensable to conduct fisheries statistics data collection in collaboration with fishery cooperatives. However, this is a challenge for many CARICOM member countries.

In order to achieve this, regular visits to landing sites by fisheries staff are very important. Catch and effort data collection and feedback after analyzing the data would be a good opportunity for the more sustainable development of coastal resources.

### **3.6. Pilot Project on Low Cost Input Small-scale Aquaculture in Belize**

#### **3.6.1. Background of the Project**

Small-scale aquaculture has been one of the most important components of aquaculture development for the purpose of the food security and poverty alleviation in the CARICOM region. It is also an important component of the management of coastal resources, such as lobster and conch, for the purpose of reducing pressure on fishing stock by creating an economically viable alternative income source for the coastal small-scale fishers.

However, despite the strong need, small-scale aquaculture is far less developed than industrial-scale aquaculture. It is difficult for small-scale fish farmers to access the techniques suitable for small-scale aquaculture because only those suitable for industrial-scale aquaculture are available, which requires high input costs due to the more intensive culture approach.

In the light of the above-mentioned, the aquaculture pilot project in Belize (pilot project for the Experiment on Low-Cost Input Small-Scale Aquaculture) was formulated and carried out from the beginning of August 2010, to achieve the following project aims and outputs.

#### **3.6.2. Purpose of the Project**

The pilot project aims to contribute to the development of aquaculture techniques that can operate with low-cost inputs, focused on the reduction of feeding costs. These techniques are suitable for small-scale tilapia farming and tend to improve its profitability. The project aims also to contribute to the CFP.

#### **3.6.3. Activities and Achievement**

An experiment was carried out to study the cost effectiveness of an alternative feed made of local materials (rice bran and mill feed) and a farming technique utilizing natural food through fertilization in the Fisheries Department's Biscayne Seedstock Production Facility and two small-scale fish farmers' sites in Sarteneja and Flowers Bank. The profitability of

small-scale tilapia aquaculture was estimated on the basis of the results of the experiments.

The first feeding experiment in the Biscayne Seedstock Production Facility was started in September 2010 and completed in February 2011. The experiment period was 21 weeks. The second feeding experiment was from the beginning of March 2011 to the end of June 2011. The experiment period was 17 weeks, four weeks shorter than the first experiment. Three new types of feed - (i) a mix of commercial feed 50% and fermented rice bran 50%; (ii) a mix of fermented rice bran 50% and mill feed 50%; and (iii) fermented mill feed 100% as inputs for non-fertilized pond groups - were introduced for the experiment.

The grow-out experiment in Sarteneja, the largest coastal fisher's community in Belize, was started at the beginning of June 2011. The fish farming facility was established by the aquaculture group formed by small-scale fishers, supported by EU funding; it was equipped with six plastic tanks and one electric air blower for aeration. 3,800 fingerlings from the Biscayne Seedstock Production Facility were stocked in this facility and were fed commercial tilapia feed, which is a floating type pellet with 35% protein content, provided by the EU-funded project.

The other grow-out experiment was carried out at a small-scale fish farm in Flowers Bank at the beginning of February 2011, soon after the first feeding experiment in the Biscayne Seedstock Production Facility had been completed. Two fish ponds were prepared, with 1,207 fishes being stocked in one pond, which had been raised with fermented rice bran and regular rice bran, and 888 fishes in the other pond, which had been raised with commercial feed. Fermented rice bran was fed to the first ones and commercial feed to the others.

The profitability of small-scale tilapia aquaculture was estimated on the basis of the result of the experiment.

### **3.6.3.1. Experiments in Biscayne Seedstock Production Facility**

#### ***First Feeding Experiment***

The result obtained from the first feeding experiment in the Biscayne Seedstock Production Facility was as follows (refer to Table 3-13 for details).

#### ***a. Feed Conversion Rate (FCR)***

The use of commercial feed and regular rice bran in the non-fertilized pond produced the best FCR, which was 2.54. The use of mill feed in the non-fertilized pond produced the worst FCR, which was 8.33. In addition, the non-fertilized pond group seemed to generally perform better than the fertilized pond group, therefore the expected improvements of FCR utilizing natural food by the fertilization process was not realized.

#### ***b. Feeding Cost***

The calculation of the feeding cost to produce 1lb. of tilapia ( $FCR \times \text{unit price of feed per}$



1lb.) showed that commercial feed was the highest (BZD1.96–2.42/lb.). Mill feed was the second highest (BZD1.09–1.25/lb.). Fermented rice bran was lower (BZD0.80–1.10/lb.) than mill feed and regular rice bran was the lowest (BZD0.43–0.86/lb.). The feeding cost of mill feed was 52–56% of commercial feed, although its cost was the highest among the alternative feed

**c. Growth Rate in Weight and the Average Body Weight at Harvest**

The growth rate of fish on the commercial feed, i.e., 66.8 – 73.7 g, was higher than that on the alternative feed, and the average body weight was about 100 g at the harvest time. Among fish on the alternative feed, the best growth rate was 40.9, which resulted from the use of fermented rice bran in the fertilized pond. The average body weight was 66.0 g. The growth rate of fish on mill feed (22.4 – 30.7) and on fermented rice bran (27.8 – 40.9) was better than that on regular rice bran (18.1 – 20.9). The average body weight of fish on regular rice bran was only 34 – 39 g.

**d. Survival Rate**

The survival rate was generally low. Even in the case of highest survival (that of fish on commercial feed in the non-fertilized pond group), it was less than 60% and in the worst case (those on fermented rice bran in the fertilized pond group) it was only 23.8%. Additionally, the fertilized pond group seemed to have a lower survival rate than the non-fertilized group.

**Table 3-13: Result of the First Feeding Experiment  
in Biscayne Seedstock Production Facility**

Fertilization	Feed Type	Stocking Date	Stocked Number	Biomass at Stocking	ABW at Stocking	Harvest Date	Harvested Number	Biomass at Harvest
Fertilized	Fermented Rice Bran	7/9/2010	965 fishes	1,557g	1.61g	2/2/2011	230 fishes	15,188g
	Commercial Feed	7/9/2010	720 fishes	1,050g	1.46g	2/2/2011	380 fishes	37,018g
	Regular Rice Bran	7/9/2010	695 fishes	1,315g	1.89g	25/1/2011	314 fishes	10,737g
	Mill Feed	7/9/2010	785 fishes	1,516g	1.93g	25/1/2011	241 fishes	14,265g
Non-fertilized	Fermented Rice Bran	7/9/2010	740 fishes	1,252g	1.69g	2/2/2011	339 fishes	15,924g
	Commercial Feed	7/9/2010	935 fishes	1,354g	1.45g	2/2/2011	550 fishes	58,714g
	Regular Rice Bran	7/9/2010	820 fishes	1,547g	1.89g	27/1/2011	396 fishes	15,595g
	Mill Feed	7/9/2010	820 fishes	2,342g	2.86g	27/1/2011	305 fishes	19,521g

Fertilization	Feed Type	ABW at Harvest	Survival Rate	Observations	Amount of feed	FCR	Feed cost / 1lb. fish	Growth rate in weight
Fertilized	Fermented Rice Bran	66.0g	23.8%	2,200 grams of other fishes observed	112,226g	6.45	BZD1.10	40.9
	Commercial Feed	97.4g	52.8%	1,650 grams of reproduction observed	121,727g	3.15	BZD2.42	66.8
	Regular Rice Bran	34.2g	45.2%		54,449g	5.07	BZD0.86	18.1
	Mill Feed	59.2g	30.7%		118,830g	8.33	BZD1.25	30.7
Non-fertilized	Fermented Rice Bran	47.0g	47.1%	1,700 grams of reproduction observed	82,837g	4.70	BZD0.80	27.8
	Commercial Feed	106.8g	58.8%		149,324g	2.54	BZD1.96	73.7
	Regular Rice Bran	39.4g	48.3%	1,030 grams of reproduction	42,178g	2.54	BZD0.43	20.9
	Mill Feed	64.0g	37.2%		142,245g	7.29	BZD1.09	22.4

### ***Second Feeding Experiment***

The results of the second experiment were as follows (refer to Table 3-14):

#### ***a. Feed Conversion Rate (FCR)***

Commercial feed in the non-fertilized pond showed the best FCR, which was 1.88. Regular mill feed in the non-fertilized pond resulted in the worst FCR, which was 5.40. Fermented mill feed had an FCR of 4.86, which was better than regular mill feed's. Mixed feed consisting of commercial feed 50% and fermented rice bran 50% had an FCR of 2.41, and mixed feed consisting of fermented rice bran 50% and fermented mill feed 50% showed 3.93. Those FCR were lower than the average figures calculated for the FCR of each component, which were 1.88 (commercial feed), 2.67 (fermented rice bran), and 4.16 (fermented mill feed). In addition, four types of feed out of the 5 that were the same feed type as in the first experiment showed better FCR than in the first experiment. Only regular rice bran in the non-fertilized pond increased the FCR compared to the first experiment.

The fermented rice bran in the fertilized pond did not show better FCR than the fermented rice bran in the non-fertilized pond. Therefore, the improvement of FCR utilizing natural food by the fertilization process was again not confirmed.

#### ***b. Feeding Cost***

The calculation of the feeding cost to produce 1lb. of tilapia (FCR x unit price of feed per 1lb.) showed that commercial feed was the highest (BZD 1.45/lb.) and mixed feed consisting of commercial feed 50% and fermented rice bran 50% was the second (BZD 1.13/lb.).

Regular mill feed was the highest (BZD 0.81/lb.) among the alternative feed. Fermented

mill feed (BZD0.73/lb.) was lower than regular mill feed (BZD 0.81/lb.). Fermented rice bran and mixed feed consisting of fermented rice bran 50% and fermented mill feed 50% were similar (BZD0.59–0.63/lb.), and lower than fermented mill feed. Regular rice bran was again the lowest (BZD0.52/lb.).

The feeding cost of mill feed was 56% of commercial feed, although it was the highest cost among the alternative feed.

#### ***c. Growth Rate in Weight and the Average Body Weight at Harvest***

The growth rate resulting from the commercial feed was 90.3 g, which was higher than that resulting from the alternative feed, and the average body weight reached was 127.3 g at the time of harvest.

Among the alternative feed, the best growth rate was 48.2 g, which resulted from fermented rice bran in the non-fertilized pond. However, the average body weight reached only 56.9 g, which was the smallest size at harvest time, because the initial size had been the smallest, as well (significance level  $\alpha=0.05$ ). The growth rate on the other fermented feed was similar (42.1 - 46.4) but slightly lower than on fermented rice bran and the average body weight was also similar (66.8 g – 77.4 g) at the time of harvest. The growth rate on regular rice bran (26.1) and regular mill feed (28.5) was lower than on the fermented ones, although the average body weight of fish at the time of harvest (61.6 g – 73.7 g) was similar to that on the fermented ones, because their initial size was larger than that of the fish on the fermented ones (significance level  $\alpha=0.05$ ).

The growth rate achieved during the second experiment was higher than during the first experiment, although the period of the experiment was four weeks shorter than the first.

#### ***d. Survival Rate***

The highest survival rate was 62.6%, which was not much improved from the 58.8% of the first experiment, although the lowest was 41.6%, which was improved from the 23.8% of the first experiment. The others were around 50%.

**Table 3-14: Result of the Second Feeding Experiment  
in Biscayne Seedstock Production Facility**

Fertilization	Feed Type	Stocking Date	Stocked Number	Biomass at Stocking	ABW at Stocking	Harvest Date	Harvested Number	Biomass at Harvest
Fertilized	Fermented Rice Bran	2/3/2011	965 fishes	1,390 g	1.44 g	28/6/2011	410 fishes	27,382 g
Non-fertilized	Commercial Feed 50%, Fermented Rice Bran 50%	2/3/2011	690 fishes	945 g	1.37 g	28/6/2011	343 fishes	35,328 g
	Fermented Rice Bran 50%, Fermented Mill Feed 50%	2/3/2011	695 fishes	1,279 g	1.84 g	29/6/2011	335 fishes	25,937 g
	Fermented Mill Feed	2/3/2011	785 fishes	1,209 g	1.54 g	29/6/2011	411 fishes	28,934 g
	Fermented Rice Bran	2/3/2011	740 fishes	873 g	1.18 g	28/6/2011	381 fishes	21,676 g
	Commercial Feed	2/3/2011	935 fishes	1,318 g	1.41 g	28/6/2011	498 fishes	63,418 g
	Regular Rice Bran	2/3/2011	820 fishes	1,935 g	2.36 g	27/6/2011	513 fishes	31,580 g
	Regular Mill Feed	2/3/2011	820 fishes	2,124 g	2.59 g	27/6/2011	341 fishes	25,144 g

***Discussion of the Result from the Biscayne Seed Stock Production Facility Experiment***

***a. Effectiveness of the Culture Techniques Utilizing Natural Food by Fertilization***

There was no evidence of improved FCR by fertilization of the ponds, although the blooming of phytoplankton occurred as a result of the fertilization. It seemed that zooplankton did not grow well in the fish pond. This condition may be related to the source of the pond water, which is not river water but ground water.

***b. Difference between the Cost of Alternative Feed Made of Local Materials and That of Commercial Feed***

On the basis of the result of the second experiment, the feeding cost of rice bran was 36–43% of commercial feed, which was lower than mill feed's of 50-56%. The growth rate on the fermented feed was much better than on the regular one; however, the growth rate was about half of that achieved using commercial feed.

Assuming that the protein content of the alternative feed is 13%, since the protein content of commercial feed is 25%, each protein efficiency ratio (PER=net growth in weight/net amount of protein) is calculated and shown in the following Table 3-15.

**Table 3-15: Protein Efficiency Ratio (PER)**

Fertilization	Feed Type	Net growth in weight	Net amount of protein	PER	Unit price of protein / lb.
Fertilized	Fermented Rice Bran	25,992 g	12,314 g	2.11	BZD1.31
Non-fertilized	Commercial Feed 50%, Fermented Rice Bran 50%	34,383 g	15,770 g	2.18	BZD2.47
	Fermented Rice Bran 50%, Fermented Mill Feed 50%	24,658 g	12,597 g	1.96	BZD1.23
	Fermented Mill Feed	27,725 g	17,511 g	1.58	BZD1.15
	Fermented Rice Bran	20,803 g	9,347 g	2.23	BZD1.31
	Commercial Feed	62,100 g	29,156 g	2.13	BZD3.08
	Regular Rice Bran	29,645 g	11,739 g	2.53	BZD1.31
	Regular Mill Feed	23,020 g	16,172 g	1.42	BZD1.15

The result shows the PER of rice bran is higher than that of mill feed. It indicates that the PER and/or protein content of mill feed is lower than that of rice bran; therefore, rice bran is better material than mill feed as an alternative feed. The PER of fermented rice bran is shown to be slightly lower than that of regular rice bran, but this does not mean that it is actually lower. Because the fermented feed, which was mixed with water when it was fermented, contains more moisture than the regular one, the fermented rice bran should have lower protein content than the regular one and a similar PER and it is nearly 20% higher than commercial feed. This suggests that the protein content of the rice bran is fully digested by the fish, although it contains protease inhibitors that inhibit enzymes from digesting the protein. However, the growth rate of fish on fermented rice bran was much higher than on regular rice bran. This indicates that the protease inhibitors are decreased by the fermentation process, so the fish can digest the protein of the fermented rice bran more quickly than they do the regular one.

### ***c. Survival Rate***

A survival rate of around 70% was expected for the 2nd experiment, because the period of the experiment and the frequency of the sampling had been reduced, as well as set fish nets to prevent them being preyed on by birds had been set. Additionally, only a few dead fish were observed throughout the experiment. However, it was not much improved; therefore, it was suspected that the most likely cause of the low survival rate was relatively high mortality at the time of seed stocking due to low oxygen contents of the pond water.

### ***Conclusions***

#### ***a. Effectiveness of the Culture Techniques Utilizing Natural Food by Fertilization***

Positive evidence of improved FCR by fertilization of the ponds was not found. This result may be related to the source of the pond water, which is not river water but ground water.

***b. Difference between the Cost of Alternative Feed Made of Local Materials and That of Commercial Feed***

Cost of the rice bran feed was 36 – 43% that of commercial feed, which was lower than the cost of mill feed. The growth rate of fish on the fermented rice bran was much better than on regular rice bran. However, it was about half the rate for the commercial feed, although the PER of it was nearly 20% higher than commercial feed. Therefore, the differentiation between fermented rice bran and commercial feed in terms of the fish’s growth rate was mainly made by the differentiation of the total protein intake from each feed. If the amount of fermented rice bran on which the fish feed is increased, the growth rate will be improved.

***c. Survival Rate***

A survival rate of around 70% for the second experiment was expected; however, it did not improve much. The most likely cause of the low survival rate was relatively high mortality at stocking time. Small net cages made of mosquito net for the initial treatment of small fingerlings to prevent the initial mortality at stocking time should be introduced .

**3.6.3.2. Experiment in Sarteneja Site**

The harvest has not yet commenced, therefore the results shown in Table 3-16 are not the final data. However, a leader of the group reported to the staff of the Fisheries Department that the fish size reached 2 fishes /lb at the beginning of November 2011.

The survival rate was 95.2% and the feed conversion rate (FCR= Amount of feed given to the fish in weight/Net growth of fish in weight) was 1.13. These were the best results of the whole experiment of the project. The fish farming facility in this site was not a fish pond but 6 circular plastic tanks, 6 m in diameter and 1.2 m in depth. The facility’s shape was the main reason the survival rate was quite high because it was easy to prevent predators from preying on the fish and to maintain the water condition. In addition, one of the reasons for the lowest FCR was that the group used high protein (35% protein content) commercial feed supplied from the EU Fund.

**Table 3-16: Results of the Experiment in Sarteneja Site**

Feed Type	Stocking Date	Stocked Number	Biomass at Stocking	Sampling Date	Counted Number	Biomass at sampling
Commercial Feed (35% protein content)	3/6/2011	3800 fishes	3,800 g	19/8/2011	3617 fishes	164,827 g

Feed Type	ABW at Sampling	Survival	Observations	Amount of feed	FCR	Feed cost / 1lb. fish	Growth rate
Commercial Feed (35% protein content)	45.6 g	95.2%		182,250 g	1.13	BZD1.08	45.6

### 3.6.3.3. Experiment in Flowers Bank Site

Contrary to the success in the Sarteneja site, the experiment in the Flowers Bank site was not successful in terms of farming fish. However, one important finding from the experiment showed that the FCR of fermented rice bran was 1.94. It was much lower than the result of the experiment in the Biscayne Seedstock Production Facility, which had its lowest FCR of 3.46 in the second experiment. The low FCR happened under a low feeding rate condition. This result strongly suggests the need to review the entire project's results, focusing on the feeding rate (Table 3-17).

**Table 3-17: Results of the Experiment in Flowers Bank Site**

Feed Type	Stocking Date	Stocked Number	Biomass at Stocking	Harvest Date	Harvested Number	Biomass at Harvest
Fermented Rice Bran	4/2/2011	1207 fishes	56,367 g	2/10/2011	547 fishes	60,937 g
Commercial Feed	4/2/2011	880 fishes	71,544 g	2/10/2011	220 fishes	35,750 g

Feed Type	ABW at Harvest	Survival Rate	Observations	Amount of feed	FCR	Feed cost / 1lb. fish	Growth rate
Fermented Rice Bran	111.4 g	45.3%	8,790 g of reproduction	85,900 g	1.94	BZD0.33	2.3
Commercial Feed	162.5 g	25.0%	13,780g of reproduction	90,400 g	2.30	BZD1.77	2.0

### 3.6.4. Lessons Learned

#### 3.6.4.1. Technical Aspect

Overfeeding and low survival rate (high mortality rate) are major factors negatively affecting the feeding rate and the PER (PER=net growth in weight/net amount of protein). If overfeeding occurs, the feeding rate apparently increases. However, the excess feed does not contribute to the growth of fish, therefore, the calculated PER tends to decrease. The remaining feed that fishes cannot find and/or cannot eat is one of the major symptoms of overfeeding. Alternative feed was not in pellet form but in powder; therefore, overfeeding easily occurred when compared to the pelletized commercial feed. In the case of survival rate, the effect depends on the fish size. If the mortality occurred at stocking time, a low survival rate does not affect the feeding rate and the PER at all; however, if the mortality occurred slightly before the harvesting time, the survival rate almost directly affects them. For instance, if the survival rate was 50%, the PER becomes nearly half and the feeding rate becomes nearly twice the actual figure.

The feeding rate was calculated for each experiment (refer to Appendix 8) and tables were made with the survival rate and protein efficiency rate for comparison (assuming that the protein content of the alternative feed is 13%).

Table 3-18 shows the survival rate in Sarteneja. It was quite high and the feeding rate was

reasonable. 2.52 was accepted as the PER of the commercial feed, which the group had used.

**Table 3-18: Survival Rate, PER and Feeding Rate in Sarteneja Site**

Feed Type	Survival Rate	PER	Feeding Rate
Commercial Feed (35% protein content)	95.2%	2.52	5.19%

In Flowers Bank, the feeding rate was quite low compared to the others, therefore, PER should not be affected by overfeeding. The survival rate could make the PER lower because at 45.3%, the PER should be higher than 3.96. It was much higher than the rate for commercial feed in Sarteneja, which might suggest the positive effect of the natural food.

**Table 3-19: Survival Rate, PER and Feeding Rate in Flowers Bank Site**

Feed Type	Survival Rate	PER	Feeding Rate
Fermented Rice Bran	45.3%	3.96	0.70%
Commercial Feed	25.0%	1.40	0.67%

In the Biscayne Seedstock Production Facility, the feeding rate in the fertilized pond was higher and the survival rate was lower than in the non-fertilized pond in the first experiment. These factors diminished the PER from the fertilized pond; hence, the effect of fertilization was not manifested on the PER. It was discussed that the water source could be a possible reason that no positive evidence could be found to improve the FCR through fertilization as indicated in the Field Report 2. However, this assumption should be reconsidered because of the above reason. The PER of the first experiment was generally low; regular rice bran in the non-fertilized pond yielded 3.03. The survival rate was 48.3%; therefore, the PER should be higher and the feeding rate should be lower than 5.53%. This suggests that the regular rice bran in the fertilized pond was oversupplied because the 10.52% feeding rate would push the PER down to 1.52. It meant that the PER of regular rice bran could be about 3.00 at the least (Table 3-20).



**Table 3-20: Survival Rate, PER and Feeding Rate of the First Experiment in the Fisheries Department Biscayne Seedstock Production Facility**

Fertilization	Feed Type	Survival Rate	PER	Feeding Rate
Fertilized	Fermented Rice Bran	23.8%	1.19	17.22%
	Commercial Feed	52.8%	1.27	9.52%
	Regular Rice Bran	45.2%	1.52	10.52%
	Mill Feed	30.7%	0.92	20.47%
Non-Fertilized	Fermented Rice Bran	47.1%	1.64	11.21%
	Commercial Feed	58.8%	1.57	7.88%
	Regular Rice Bran	48.3%	3.03	5.53%
	Mill Feed	37.2%	1.06	16.25%

The PER of the second experiment was higher than that of the first experiment except when regular rice bran was utilized, although the feeding rate and the survival rate were similar to those of the first experiment. The first experiment was carried out during the rainy season while the second one was conducted in the dry season. The result suggested that the feeding rate was relatively stable; however, PER has a tendency to change depending on the season. The feeding rate differed according to feed type. The smallest was regular rice bran and the second was commercial feed. On the other hand, fermented rice bran was the second largest next to feed mill. In the case of regular rice bran, the feeding rate was higher than in the first experiment; overfeeding pushed the PER down to 2.53 (Table 3-21).

**Table 3-21: Survival Rate, PER and Feeding Rate of the Second Experiment in the Fisheries Department Biscayne Seedstock Production Facility**

Fertilization	Feed Type	Survival Rate	PER	Feeding Rate
Fertilized	Fermented Rice Bran	42.5%	2.11	12.26%
Non-Fertilized	Commercial Feed 50% Fermented Rice Bran 50%	49.7%	2.18	9.16%
	Fermented Rice Bran 50% Fermented Mill Feed 50%	48.2%	1.96	12.87%
	Fermented Mill Feed	52.4%	1.58	16.28%
	Fermented Rice Bran	51.5%	2.23	11.74%
	Commercial Feed	53.3%	2.13	7.43%
	Regular Rice Bran	62.6%	2.53	8.69%
	Regular Mill Feed	41.6%	1.42	15.83%

#### 3.6.4.2. Financial Aspect

The profitability of the small-scale tilapia farming using six plastic farming tanks was estimated on the basis of the information obtained from the Sarteneja group. The result showed that income was BZD 16,200, and total expenditure was BZD 10,570. Net profit was BZD 5,630 using the following conditions for the estimation

Farming facility: 6 plastic tanks, Holding capacity: 300 lb/tank, Harvest size: 2 fishes/lb., Harvest cycle: 3 times/year, Sales: 100–200 lb. /week regularly, Sales price: EZD3.00/lb.

To calculate the expenditure, yearly payment of principal and interest for the loan of the facility was included, which was EZD 12,000 for the principal for a term of ten years with an annual interest of 10%.

**Table 3-22: Estimated Income and Expenditure (Plastic Tanks)**

	Unit price	Quantity	Amount	Remark
<b>Income</b>	3	5,400 lb.	<b>16,200</b>	300lb*6tanks*3times
<b>Direct cost</b>				
Fingering cost	0.15	11,400 fishes	1,710	3,800 fingerlings*3times
Feed cost	0.95	6,102 lb.	5,797	Commercial feed 35%protein content FCR1.13
Gasoline	3	180 L	540	6L/times*10times*3taimes
Electricity	0.5	576 KWH	288	8hours*30days*0.8kw*3times
Others			300	
<b>Subtotal</b>			<b>8,635</b>	
<b>Repayment of loan for Facility</b>			<b>1,935</b>	Lovell yearly payment of principal and interest
(Loan of Facility)	(6)	(2,000)	(12,000)	10 years yearly interest rate=10%
<b>Total Expenditure</b>			<b>10,570</b>	
<b>Net profit</b>			<b>5,630</b>	Net profit rate 34.8%

The profitability of fish farming using a pond was also estimated. The results showed that yearly income was BZD 20,400 and total expenditure was BZD 14,935, providing a net profit of BZD 5,465 (assuming the following conditions for the estimation. Farming facility: 30 m x 15 m pond, Holding capacity: 3,400 lb/pond, Harvest size: 2 fishes/lb., Harvest cycle: 2 times/year, Sales: 100–200 lb/week regularly, Sales price: EZD 3.00/lb. To calculate the expenditure, the yearly payment of principal and interest for the loan of the farming facility was added, which was EZD 5,000 for the principal for a term of 20 years at 10% interest. Both estimates indicated that the net profit for the small-scale tilapia farming using 6 plastic tanks or fishponds was around EZD 5,500 at EZD 3.00/lb. sales price (Table 3-22, 23).

**Table 3-23: Estimated Income and Expenditure (Fish Pond)**

	Unit price	Quantity	Amount	Remark
<b>Income</b>	3	6,800 lb.	<b>20,400</b>	Calculated Based on pond area Pond area/Tank area = 17 2times /year Holding capacity=2/3 of tank because of no aeration
<b>Direct cost</b>				
Fingering cost	0.15	26,917 fishes	4,038	Calculated Based on pond area Pond area/Tank area = 17 2times /year Survival rate=80% of tank
Feed cost	0.95	8,538 lb.	8,111	FCR=1.13/0.9 because of mortality
Gasoline	3	400 L	1,200	100L/times*4times
Electricity	0.5		0	
Others			1,000	
<b>Subtotal</b>			<b>14,348</b>	
<b>Repayment of loan for Facility</b>			<b>587</b>	Lovell yearly payment of principal and interest
(Loan of Facility)	1	5000	5,000	20 years yearly interest rate=10%
<b>Total cost</b>			<b>14,935</b>	
<b>Net profit</b>			<b>5,465</b>	Net profit rate 26.8%

According to the Belize Capture Fishery Annual Report 2008, the total export value of Lobster tail and Conch meat was BZD 20,367,000 in 2008 and BZD 22,234,000 in 2007. The registered number of coastal fishermen totaled 2,267 in 2008 and 2,110 in 2007; therefore the annual production per fisherman was about BZD 9,000 in 2008 and BZD 10,500 in 2007 in export values. Assuming that the sales value from fishermen to exporter was 70% of the export value, the cost of coastal fishing was 30% of the income; hence, an average fisherman's net profit was estimated at BZD 4,400 in 2008 and BZD 5,200 in 2007.

These figures indicated that small-scale tilapia farming could be a viable alternative income-generating activity to the existing coastal fishing activity targeting lobster and conch. However, the initial required capital until the first harvest was BZD 12,000–15,000, which was about three times the yearly net income of coastal fishermen. It seemed that an individual fisherman would have difficulty engaging in tilapia farming by himself. It was essential to form an aquaculture group of fishers to be able to raise the initial funds required. In the case of the Sarteneja group, the members had established the group for the purpose of seeking the initial funds from outside sources. It took them about three years to obtain the EU funding.

The above estimates of the profitability of fish farming indicated that feeding costs made up the largest portion of the direct cost. Once accurate data had been acquired about the feed such as maximum feeding rate, PER, and price, the feeding process could be simulated and then evaluated for possible reduction of the feeding cost. For example, by using more fermented rice bran for larger fish instead of commercial feed, as shown in Table 3-24, the feeding cost could

be reduced by 24% for the same culture period and same target size. (Refer to Appendix 9)

**Table 3-24: Simulation of the Feeding Cost**

Feeding Method		Protein content of feed	Culture period	Feeding cost /1000fish	Remark
Target size	Feeding rate				
1-225g	5%	35%	127days	BZD 564	Commercial feed (protein content 35%) 100%
1-75g	7%	35%	73days	BZD 190	Commercial feed (protein content 35%) 100%
75-150g	5%	20%	28days	BZD 146	Fermented rice bran 68.2% Commercial feed (protein content 35%) 31.8%
150-225g	5%	13%	25days	BZD 91	Commercial feed (protein content 35%) 100%
Total			126days	BZD 427	Feeding cost =75.7% of commercial feed 100%

### 3.6.5. Recommendation for Regional Development

The results of the pilot project indicated that there is a high probability that small-scale tilapia aquaculture can work as an alternative income source for the small-scale coastal fishers. Modifications could be made to make it more suitable to local conditions but further experiments and initiatives would be needed taking into account the following considerations:

#### 3.6.5.1. Technical Aspect

- a. Determine more accurate PER and maximum feeding rate of each feed for the purpose of minimizing the feeding cost while securing survival rate as well. Utilizing plastic tanks as in the Sarteneja site could be an ideal solution.
- b. Examine the method of fermentation of alternative feed focusing on the improvement of its digestibility.
- c. Examine the effect of pelletized alternative feed with emphasis on reducing the unutilized portion of the feed.

#### 3.6.5.2. Management Aspect

- a. Recommend to small-scale coastal fishers the establishment of a fish farming group for those fishers interested in small-scale tilapia farming in the coastal community.
- b. Establish a model fish farming group that can assist other fisher groups that wish to engage in small-scale tilapia farming.

#### 3.6.5.3. Financial Aspect

- a. A group approach is essential to accessing funds to start the fish farming activity. Encourage the group to tap local banks and/or international/local donors for fund sources.

### 3.7. Pilot Project on Aquaculture Training and Extension in Jamaica

#### 3.7.1. Background of the Project

During the baseline survey, it was found that small-scale aquaculture development was not progressing as expected in the CARICOM member countries. One of the reasons for the poor performance was inadequate extension services for small-scale fish farmers. The issue was typically stated in Jamaica and became clear that it is the core problem during the participatory workshop. According to the discussion, many of these root causes may be attributed to the lack of clear aquacultural development policy and strategy. The pilot project on aquaculture training and extension was carried out in Jamaica. The pilot project had two components 1) local extension program of small-scale tilapia culture and 2) regional program on formulation of aquaculture development plans.

#### 3.7.2. Local Extension Program of Small-scale Tilapia Culture

##### 3.7.2.1. Purpose of the Project

The local program of the pilot project aimed at verifying the proper extension models for small-scale fish culture activities. In the local program, Jamaican fish farmers learned proper technical and management skills for small-scale tilapia culture. After the local training program, the local fish farmers tried to stock and culture tilapia in their own ponds, with regular extension visits and technical support provided by the staff of the Fisheries Division in Jamaica. The fish culture operation of local farmers and the technical support and advice provided by the extension officers were evaluated at the middle and end of the pilot project.

##### 3.7.2.2. Activities and Achievement

The following activities of the local programs were carried out under the pilot project (Table 3-25).

**Table 3-25: Schedule of Main Activities in the Local Program**

Main Activities	Period / Date
Baseline survey in small-scale fish culture	September to October 2010
Supplementary field visits to small-scale fish farmers	November to December 2010
Rehabilitation of demonstration ponds at Aquaculture Branch	October to December 2010
Preparation of technical manuals and other arrangements for local training program	January to February 2011
Local training program for small-scale fish farmers at Aquaculture Branch	February 22 to 24, 2011
Fish fingerling delivery to fish farmers	March to April 2011
Extension visits to fish farmers (total of 6 times for all farmers)	March to August 2011
Mid-term evaluation workshop of monitoring program at Aquaculture Branch	June 23, 2011
Fish sale demonstration with local fish farmers at Denbigh Agriculture Show 2011 (Annual National Agriculture Fair)	July 31 to August 2, 2011
Final evaluation workshop of monitoring program at Aquaculture Branch	August 23, 2011
Data analysis and finalization of pilot project report	September 2011
Final presentation session of local program in Fisheries Division	September 28, 2011

Twenty-five local fish farmers participated in the local training program, which was held in

February 2011 in Jamaica. Ten fish farmers from among the local training participants, who were selected on the basis of the baseline survey, were engaged in the monitoring program. As an additional activity, the project supported fish farmers' participation in the national agricultural fair, Denbigh Agriculture Show 2011, with Fisheries Division of Jamaica, to promote and improve the marketing of their cultured tilapia fish at public markets. In the three-day fair, 500 lbs of smoked and cooked tilapia and 130 lbs of live tilapia were sold at a project booth by local farmers.

The achievements of the local programs' objectives are described as follows.

### ***Effect of fish culture techniques***

According to the responses to a survey questionnaire administered as part of the final evaluation, most local fish farmers participating in the monitoring program confirmed that their technical levels of tilapia culture had improved during the pilot project. Table 3-26 shows the improvement level of respective technical subjects in the pilot project. The improvement levels for "Feeding management" and "Pond water management" are significantly higher than for other technical subjects. In addition, the improvement levels for "Record keeping" and "Fish harvest" are a little lower than for the technical subjects mentioned above.

**Table 3-26: Technical Improvement of Tilapia Culture on Final Evaluation**

Main Technical Subject (Evaluation Point / 10%)	Much Improved (3 pt.)	A Little Improved (1 pt.)	Not Improved (0 pt.)	No Answer	Evaluation Points
Feeding Management	60 %	30 %	10 %	0 %	21 pt.
Pond Water Management	70 %	10 %	20 %	0 %	22 pt.
Record Keeping	40 %	60 %	0 %	0 %	18 pt.
Fish Harvest	60 %	0 %	30 %	10 %	18 pt.
Fish Health Control	50 %	50 %	0 %	0 %	20 pt.

Note: Evaluation points are calculated by adding the points earned at each evaluation criteria. The perfect score is 30 evaluation points. (Total =10 respondents)

### ***Effect of Fish Culture Production***

To compare the management conditions of fish culture operations, three clusters of FCR (feed conversion rate) efficiency levels are tentatively set as shown in Table 3-27. In the case of the farmers who had high FCR efficiency (Cluster A), the average percentages of feed costs on sale prices is only 30%. The farmers belonging to this cluster made good profits through their culture fish sales. For the farmers who had middle FCR efficiency (Cluster B), the average percentage of feed cost is about 50%, much higher than Cluster A. However, they could enjoy a small profit from fish sales. In the case of the farmers who had low FCR efficiency (Cluster C), the feed cost is much higher than the fish sale price. Since the same brand of commercial feeds were used in this monitoring program to grow tilapia fish for all fish farmers, the different nutritional effects of fish feeds are negligibly small. Therefore, the survival rate of cultured fish

in ponds largely influenced the cost management of local fish culture operations.

**Table 3-27: Estimated Management Conditions at Different FCR Level Clusters in the Monitoring Program**

Clusters of FCR efficiency	Number of Famers	Range of FCR	Average of FCR	Estimated Feed Cost per kg of Fish (J\$50/kg)	Percentage of Feed Cost on Sale Price (J\$330/kg)	Average of Survival Rate
A: High	4	1.46 - 2.37	1.96	J\$ 98.0	29.7 %	66.0 %
B: Middle	3	2.76 - 3.53	3.17	J\$ 158.5	48.0 %	42.7 %
C: Low	3	4.39 - 10.92	6.86	J\$ 343.0	103.9 %	32.7 %

Note: The estimated feed price is referred to that of local commercial feed for tilapia culture produced by HI-PRO, a local feed factory. The regular price of HI-PRO mash or pellet feeds is J\$1,100 - 1,250 per bag (25 kg). The market price of fresh tilapia fish is J\$ 150 - 200 / lb (J\$ 330 - 440 /kg).

According to the evaluation results of the monitoring program, the following conditions are identified as negative factors that affect the survival rate and reduce fish production:

- Loss of motivation and intention for fish culture operations
- Predation of culture fish by wild animals (birds, crocodiles, etc.)
- Less water change of fish ponds due to water flow's sudden cessation
- Overgrowth of aquatic plants and weeds in fish ponds
- Theft of cultured fish from ponds
- Leakage of water from cracks in fish ponds

#### ***Effect of Extension Services***

The regular extension visits of extension officers from the Aquaculture Branch, Fisheries Division of Jamaica, were conducted monthly as originally planned. The actual schedule of their extension visits is shown in Table 3-28.

**Table 3-28: Schedule of Fish Fingerling Delivery and Extension Visits to Fish Farmers for Fish Farmers' Clusters**

Cluster (No. of farmers)	Fingerling Delivery	Date of Extension Visits					
		1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>
St. Thomas (3)	Mar. 1	Apr. 14	May 3	May 18, 25	Jun. 17, 19	Jul. 12	Aug 11
Clarendon and St. Mary (3)	Mar 10, 24	Apr. 11, 13	May 4, 6	May 25	Jun. 16	Jul. 13, 14	Aug 16, 17
St. Catherine (2)	Mar. 26, Apr. 7	Apr. 15	May 5, 8	May 18, 26	Jun 20, 28	Jul. 18	Aug. 20
St. Andrew (2)	Mar. 23, Apr 8	Apr. 12	May 6	May 26	Jun. 21	Jul. 11	Aug 17

Most fish farmers expressed considerable satisfaction with the regular extension visits, because the extension services facilitated and motivated the continuation of their fish culture activities. Moreover, most fish farmers expect the continuation of similar extension services by

the Fisheries Division in order to improve their technical skills and production levels (Tables 3-29, 3-30).

**Table 3-29: Satisfaction of Extension Visits to Fish Farmers in the Final Evaluation**

Main Extension Subject (Evaluation Point / 10%)	Much Satisfied (3 pt.)	A Little Satisfied (1 pt.)	Not Satisfied (0 pt.)	No Answer	Evaluation Points
Sampling	90 %	0 %	10 %	0 %	27 pt.
Technical Advice	80 %	10 %	0 %	10 %	25 pt.
Contact with extension officers	90 %	0 %	0 %	10 %	27 pt.

Note: Evaluation points are calculated by adding the points earned at each evaluation criteria. 30 point is a perfect score in the evaluation points  
(Total = 10 respondents)

**Table 3-30: Future Operation of Fish Culture after the Pilot Project**

	Yes	No	No Answer
Necessity of extension services after the pilot project	100 %	0 %	0 %
Continuation of fish culture after the pilot project	90 %	0 %	10 %
Expansion of fish ponds in near future	90 %	0 %	10 %

(Total = 10 respondents)

### 3.7.2.3. Lessons Learned

There were following contributing and inhibiting factors in the local program, the extension program for small-scale tilapia culture.

#### *Contributing Factors*

##### *a. Motivation for Fish Culture*

The motivation of fish farmers is the most significant factor to improve their fish culture operation and production. Some highly motivated fish farmers experienced very successful fish production due to proper daily feeding of fish and maintenance of pond water. However, a few farmers lost a lot of cultured fish because of their low motivation, lost interest, and inattention in feeding and observing their fish.

##### *b. Group Work of Fish Farmers*

Fish farmers in the Parish of Clarendon Cluster often worked together and helped each other in the fish culture works. When a fish farmer lost many cultured fish because his fish pond dikes broke, others supported him in moving the remaining fish to other ponds and in restarting his fish culture operation.



## ***Inhibiting Factors***

### ***a. Predation of Wild Animals***

Wild animals like birds and crocodiles often invade fish ponds to prey on cultured fish. Once wild animal predation starts, the survival rate of cultured fish in ponds is reduced. Predation by wild animals is therefore a serious factor leading to decreased fish production.

### ***b. Overgrowth of Aquatic Plants and Weeds***

Aquatic plants and weeds may grow rapidly and fill the fish ponds in a short time. At a fish farm in St. Thomas, aquatic plants suddenly grew from scratch and covered the entire pond surface within only a few weeks. The overgrowth of aquatic plants and weeds negatively affects the efficiency of fish conditions because it causes a large drop of DO (dissolved oxygen) levels in pond water at night time.

### ***c. Long Period of Fish Culture***

In the monitoring program, fish farmers cultured tilapia fish in five to six months, from fingerling stock to harvests of market-size fish. However, in local vegetable or poultry farming, the production cycle takes only three to four months. Compared to other crop farming systems, the current production period for tilapia fish is long for local fish farmers.

### ***d. Theft of Cultured Fish***

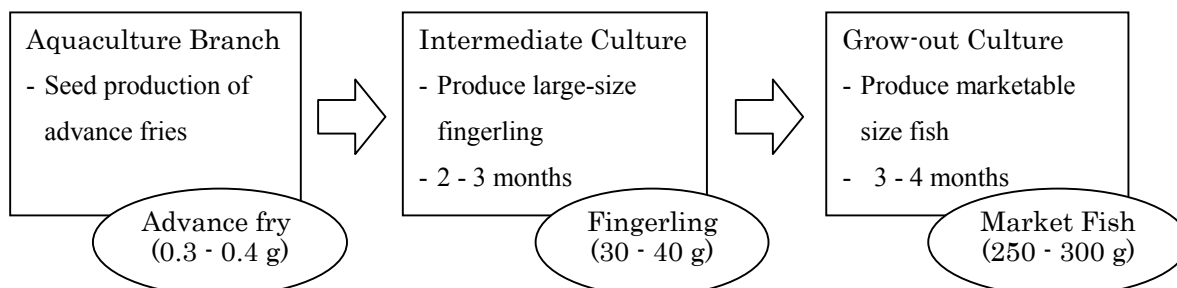
Since fish ponds are usually located in remote areas, cultured fish are easily stolen from fish ponds at night. During the monitoring program, no serious case of theft of cultured fish was reported. The reason may be that most fish farmers visited the fish ponds for feeding and observation every day.

## **3.7.2.4. Recommendation**

### ***Promotion of Intermediate Culture to Produce Large-Size Tilapia Fingerlings***

Considering the future promotion and expansion of small-scale tilapia culture production all over the country (Jamaica), the capacity for tilapia seed production at the Aquaculture Branch, Fisheries Division of Jamaica, will not be adequate to meet the expected future fingerling demands by local fish farmers. Because of limited fish pond space for tilapia seed production, the Aquaculture Branch cannot increase the production capacity for tilapia fingerling on a large scale. To increase and maintain the local supply of tilapia fingerlings to small-scale farmers, the intermediate culture activities of fingerling production should be promoted to local fish farmers. Intermediate culture farmers can purchase advance fries (0.3 – 0.4 g size) from the Aquaculture Branch, and grow them into fingerlings (30 – 40 g size) in two to three months. The fingerlings produced can then be sold to grow-out fish farmers. The introduction of the intermediate culture operation will significantly reduce the grow-out culture stage period. The operational risks of small-scale fish culture can be shared between

intermediate and grow-out farmers (Figure 3-3).



**Figure 3-3: Proper Promotion Model for Small-scale Tilapia Culture**

#### ***Prevention of Wild Animal Predation***

The predation of wild animals like birds or crocodiles has a large negative effect on fish production. According to the result of the monitoring program, some fish farmers largely lost their cultured pond fish by wild animal predation. Therefore, the installation of fences around ponds or bird deterrent lines above the ponds should be promoted to local fish farmers to minimize their predation loss.

#### ***Promotion of Organization of Small-scale Fish Farmers***

In a cluster of the monitoring program, fish farmers worked together and supported each other in their fish culture operations. That social situation also contributed to the improvement of their technical skills in fish culture, because fish farmers often shared their information and experiences in the cluster group. They also started to sell their cultured fish jointly at local markets. Therefore, a proper organizational structure of local fish farmers should be considered for promoting small-scale fish culture.

#### ***Introduction of Herbivorous fish to Control Aquatic Weeds in Fish Ponds***

The result of the monitoring program identified that the overgrowth of aquatic plants or weeds deteriorates fish pond conditions. At present, the only countermeasure is for the fish farmer to cut and collect the aquatic plants and weeds in the fish ponds by hand. In order to reduce the heavy labor involved, herbivorous fish could be introduced to control the growth of weeds and plants in fish ponds.

#### ***Promotion of Record Keeping of Fish Culture Activities***

In the monitoring program, the regular record keeping with regard to fish culture operations provided fish farmers with useful information to improve their technical and business management skills. Using the fish culture records in the monitoring program, some fish farmers started to estimate and monitor their proper financial status so as to improve their fish culture operation. Those fish culture records also motivated the fish farmers to monitor carefully, maintain, and improve regular fish culture activities. Therefore, the efforts at record keeping

possibly affected their fish production.

### **3.7.3. Regional Program on Formulation of Aquaculture Development Plans**

#### **3.7.3.1. Purpose of the Project**

The pilot project aims at formulating action plans for aquaculture development in the respective target countries and discussing ideas for a regional network structure in aquaculture development. Two regional workshops were convened under the pilot project. Six countries, Belize, Guyana, Haiti, Jamaica, Suriname, and Trinidad and Tobago, were selected as target countries for the workshop, on the basis of their interest and future potentials for aquaculture development.

#### **3.7.3.2. Activities and Achievement**

The activities of the regional programs were carried out under the pilot project as shown in Table 3-31.

**Table 3-31: Schedule of Main Activities in Regional Program**

Main Activities	Period / Date
Preparation meeting of regional program between Fisheries Division of Jamaica and CRFM Secretariat	October 2010
Preparation of the regional workshops	November 2010 to February 2011
First regional workshop on aquaculture development planning (Hotel Four Seasons, Kingston, etc.)	March 14 to 22, 2011
Intersession activities for action planning on aquaculture development in respective countries (presentation of ideas of action plans, discussion on aquaculture development plans with local stakeholders, revision of project design matrixes of action plans, and others)	April to August, 2011
Second regional workshop on aquaculture development planning (Hotel Four Seasons, Kingston, etc.)	August 29 to 31, 2011

In the first workshop, the participants formulated draft action plans on aquaculture development in their respective countries using a participatory approach to the PCM (Project Cycle Management) method. During the second workshop, the participants presented the actual progress made with the preparation of their action plans on aquaculture development on the basis of the first workshop outputs, and discussed the establishment of a regional aquaculture network in the Caribbean. Participants were also updated on the progress and results of the aquaculture pilot projects in Belize and Jamaica.

The achievements of the regional program's objectives are described as follows.

#### ***Progress of Intersessional Activities***

Most workshop participants conducted the planned intersession activities in their respective countries to modify their draft action plans on aquaculture development. The progress of

intersession activities in target countries are indicated in Table 3-32. Notably, in Belize, the Department of Fisheries held a two-day PCM workshop to discuss future aquaculture programs based on the outputs of the first regional workshop.

**Table 3-32: Progress of Intersessional Activities between the First and Second Workshops in Respective Target Countries**

Target Countries for Regional Workshop	Progress of Intersession Activities		
	A. Presentation of draft action plans of aquaculture development in fisheries offices	B. Discussion on aquaculture development plan with local stakeholders	C. Revision of project design matrix of action plan in accordance with discussion with local stakeholders
Belize	Done	Done	Done
Guyana	Done	Done	Done
Haiti	Done	Not Yet	Not Yet
Jamaica	Done	Done	Done
Suriname	Done	Done	Done
Trinidad & Tobago	Done	Done	Done

Source: Progress reports of second regional workshop

Based on analyses by the PCM approach, the main components of countries' action plans formulated in the regional workshop are indicated as shown in Table 3-33.

**Table 3-33: Components of Action Plans of Aquaculture Development in Respective Countries Formulated in the Regional Workshop**

Country	Components of Country Action Plan
Belize	<ul style="list-style-type: none"> <li>- Improved designation of aquaculture operations</li> <li>- Improved screening of loan applications by banking institutions</li> <li>- Decrease of fish production costs</li> </ul>
Guyana	<ul style="list-style-type: none"> <li>- Development of capacity in aquaculture sector and research on quality feed</li> <li>- Improvement of aquaculture business management</li> <li>- Improvement of marketing of cultured fish</li> <li>- Improvement of communication with farming communities</li> <li>- Establishment of quality assurance and safety of aquaculture products</li> <li>- Establishment of aquaculture policy and zoning</li> </ul>
Haiti	<ul style="list-style-type: none"> <li>- Availability of feed stocks at affordable prices</li> <li>- Increase of cultured fish quality</li> <li>- Availability of aquaculture equipments for local farmers</li> </ul>
Jamaica	<ul style="list-style-type: none"> <li>- Increased supply of quality seed stocks</li> <li>- Increased access to markets</li> <li>- Increased incomes generated by fish farmers</li> <li>- Strengthened capacity of extension services</li> </ul>
Suriname	<ul style="list-style-type: none"> <li>- Lowering the cost of exploitation</li> <li>- Rehabilitation of aquaculture farms</li> <li>- Zoning plans of aquaculture development</li> <li>- Establishment of aquaculture research and training center</li> <li>- Publication of aquaculture handbooks</li> </ul>
Trinidad and Tobago	<ul style="list-style-type: none"> <li>- Provision of training to farmers, extension personnel and laborers</li> <li>- Formulation of a policy document which would guide the development of sustainable aquaculture</li> <li>- Reduction of capital and revenue expenditure whilst optimizing profitability of aquaculture enterprises</li> <li>- Determination of marketing opportunities, baseline prices, marketing tools and strategies for aquaculture production</li> </ul>

### **3.7.3.3. Lessons Learned**

#### ***Subjects for Regional Programs***

The main subject of the first workshop, participatory planning using the PCM method, was well received by the workshop participants. Most participants said the planning method could be applied to other areas of their work. In addition, most of them indicated that the “technical aspects of fish culture” and “marketing and processing of cultured fish” should be considered as necessary subjects in future regional programs for aquaculture development in the Caribbean. Moreover, most of them also recognized the importance of establishing a regional network on aquaculture development in the workshop series. The maintenance of further contact and communication among the participants was also discussed in the workshops.

### **3.7.3.4. Recommendation for Regional Development**

#### ***Establishment of Regional Network in Aquaculture Development***

Based on discussions on a presentation on the Formation of a Regional Network of Aquaculture Agencies/Institutions at the First Regional Workshop and subsequently a Concept Note on a Regional Network of Aquaculture Organizations at the Second Regional Workshop, it was recommended that CRFM should play a key role in supporting and managing the establishment of a regional aquaculture network similar to NACA (Network of Aquaculture Center in Asia-Pacific).

#### ***Establishment of a Regional Center Function for Aquaculture Development***

In order to ensure region-wide aquaculture programs function effectively and build capacity, a proper structure for managing and monitoring the regional programs is necessary. However, because of financial constraints in CARICOM, it is not realistic to establish and manage a new regional center for aquaculture development programs. Hence, existing aquaculture facilities in the countries should be improved and utilized as “Centers of Excellence for Aquaculture” in the region. As necessary, the existing facilities will be rehabilitated and reinforced and used as centers to conduct national and regional programs.

## **3.8. Lessons Learned from the Implementation of Pilot Projects**

Lessons learned and the recommendations from the implementation of the pilot projects reconfirmed the approaches that could improve the situation of resource management focused on seven critical concerns.

### **3.8.1. Formulation of resource management policies, plans, and measures**

FAD fishery management plan is being prepared with participation of fishers and fisheries authority. Fishers’ own initiatives and participation ensures the practicality of the formulation of resource management policies, plans and measures. Both the Technical and financial support of FAD fishery stimulated the formulation process.

### **3.8.2. Diversification and improvement of the efficiency in fishing activities**

Diversification of fisheries with precautionary utilization of non or under-utilized fishes along with the collaboration of fishers proved workable. Appropriate technical assistance based on communication between fishers and fisheries authorities was essential, with economic benefits crucial for fishers to participate in new fishing activities.

### **3.8.3. Marketing**

Marketing for a new species was undertaken. Regarding diamond back squid (DBS) fishery, a group of fishers and a fishery authority was formed to promote the sale of DBS. DBS processing workshop and tasting event inviting chefs from restaurants showed a potential market for tourism.

### **3.8.4. Improvement of fisheries resource information**

The Participation of fishers in statistical data collection was found essential. Participatory resource management starts with an understanding of the resource situation by fishers themselves. Communication between fishers and fisheries authorities needs to be strengthened through regular meetings, as well as providing feedback to the information given by fishers.

### **3.8.5. Development of alternative income sources**

Small-scale aquaculture shows potential as an alternative income source for small-scale fishers. Participation of a group of fishers in aquaculture reduces fishing pressure on lobster and conch fishery.

### **3.8.6. Participatory resource management**

As noticed from the above experience, the participatory approach is at the core of resource management in data collection, formulation of management plan, reduction of fishing pressure through diversification of fishing activities, and development of alternative income sources.

### **3.8.7. Regional networks**

Sharing information and technologies has proved to be much needed among member countries. The creation or enhancement of regional networks is essential. Following challenges for CRFM were identified during the implementation of pilot projects.

In order to implement activities for sustainable use of fisheries resources in coastal community development, it is essential to utilize the existing framework of regional cooperation. During the implementation of the pilot projects, it was confirmed that the project host countries were eager to share their experiences with the participants from other countries. Future knowledge sharing activities using this regional network require an effort to identify appropriate topics and the leadership of a host country. The role of CRFM is to appropriately coordinate

member countries to work in such a manner. However, CRFM is still young and in a process of development; CRFM Secretariat has yet to function at its full potential. It is economical to utilize CRFM rather than establish a new networking organization. Following challenges of CRFM were identified during the implementation of the pilot projects.

### **3.8.8. Challenges of CRFM**

#### **3.8.8.1. Communication**

The national fisheries administrations in the Caribbean region face many issues ranging from policy concerns to technical questions as well as regional responsibility. CRFM Secretariat is responsible for various levels of communication among the fisheries administrations of the member countries. One of the roles of the secretariat is to provide technical advisory and consultative services to the fisheries divisions. The Secretariat coordinates and organizes regular meetings, including ministerial meetings, forum meetings, and scientific meetings. Meanwhile, under donor funded projects, other meetings/workshops are held. However, it is still necessary to improve communication among the member countries to address policy, management, legal and other technical issues. The importance of face-to-face meetings and on-site training is certain. However, the priority to conducting meetings must be reevaluated in light of the global recession and limited budget contributions from the member countries.

#### **3.8.8.2. Resource Mobilization (Government, Private, Fishers)**

Shortage of administrative and technical staff is common to the Secretariat and most of the member countries. Facilities and equipment needed to implement CRFM's programs at the national and regional levels are expensive both to acquire and utilize

With technical assistance from JICA, CFTDI took leadership in implementing a training program in fishing technology, fish processing technology, boats engine and refrigeration mechanics in the region. The Study team members often heard the request for the revival of such training courses.

CFTDI still has experts trained during JICA project and are presently conducting courses for mainly Trinidad and Tobago participants, with other countries being accommodated once a request is made and funding becomes available. CFTDI is entering into MOU arrangements with other institutions in the region to facilitate easier access to their training programs.

CFTDI was willing to provide assistance to member countries and assigned the trainers to the pelagic fishery resource management and development pilot project implemented in Dominica and St. Lucia. It is hoped in the future that CRFM will continue coordinating collaboration with CFTDI with needed funding.

Although CRFM has a formal agreements with the IMA, University of the West Indies, and other research institutions, collaborative activities are limited due to a lack of communication and funding. Moreover, it is necessary to enhance the utilization of experienced staff members from both the national fisheries administrations as well as fishers from member countries.

## 4. Strategies

Issues and constraints pertaining to fisheries resource management in the region were discussed in the previous chapters by taking similarities and differences of CARICOM member countries into consideration in terms of environmental, social, and economic conditions. The following vision and goals were determined after careful assessment of the current status of the sector, the results of pilot projects, and other relevant information.

### 4.1. Vision and Goals for the Caribbean Region-wide Fisheries Development and Management Plan

**Vision:** Coastal communities in the Caribbean region will have a better quality of life with a higher standard of living while becoming more resilient to external changes in the climate and natural environment.

**Long-Term Goal:** Co-management of fisheries resources becomes common in the region in ten years with 80% of member countries exercising this principle.

**Medium-Term Goal:** Co-management models are adapted in several countries with the use of regional working groups and other mechanisms such as national working groups and fishers' organizations. Within five years the management capacity of the CRFM including its Council, Forum, Secretariat, working groups, and national fisheries authorities is enhanced and CRFM's governance is improved.

**Short-Term Goal:** Practical co-management models for sustainable use and management of fisheries resources are established through community-based projects for fisheries management in selected countries in three years. Legal and regulatory instruments for supporting the co-management are also formally established. Information regarding practical co-management models with legal and regulatory instruments is shared with other member countries.

### 4.2. Strategy to Achieve the Vision and Goals

In order to achieve the vision and goals, the following guiding principles and approaches were formulated. These guiding principles and approaches were preliminary determined based on the analysis of sector issues (Chapter 2) and verified through implementation of pilot projects (See Table 4-1). Promotion of participatory resource management and the formation and strengthening of the regional network are basic conditions in order to achieve resource management in the Caribbean region and are considered guiding principles. Four approaches selected here indicate effective ways to achieve this vision and goals. Figure 4-1 shows the relationship among issues and those principles/approaches.

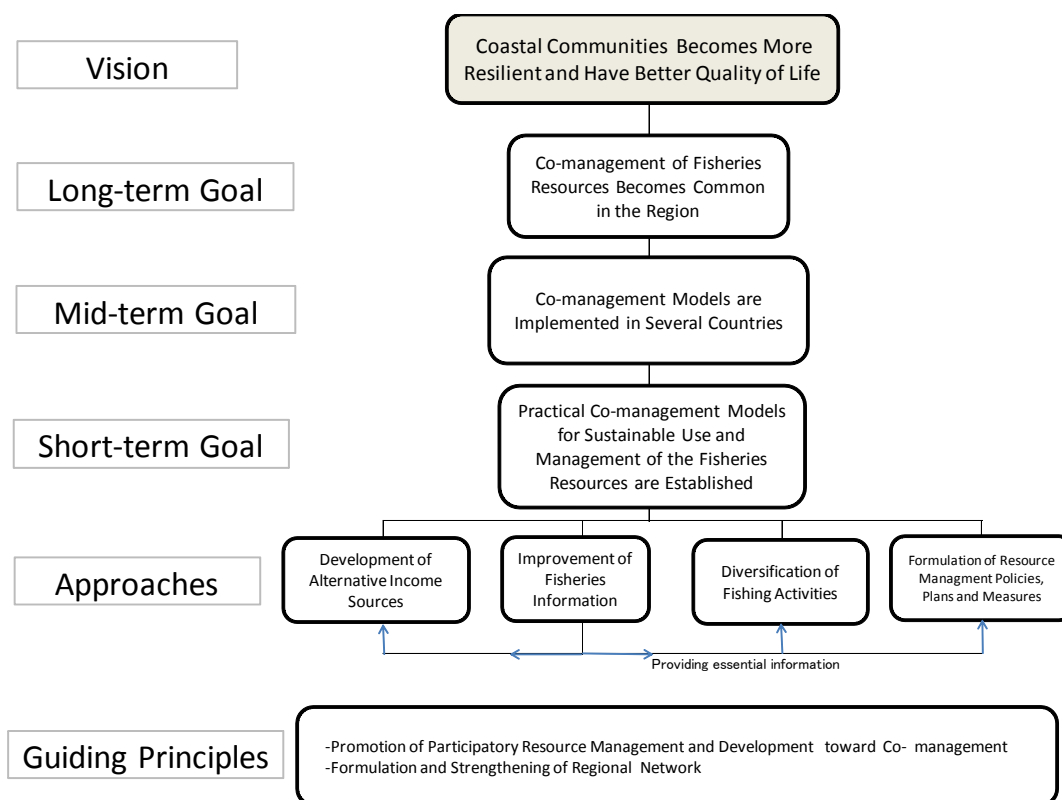


Marketing is recognized as an important issue for fisheries development. However, it should be noted here that marketing activities usually are based on each species and its demand. Offshore pelagic fish, diamond back squid, demarsal fish, lobster, conch, tilapia and other aquaculture products have different markets and thus require different marketing strategies. Therefore instead of considering marketing as an independent approach, the study has decided to include a marketing aspect in each stated approach. By doing so, marketing activities will realize more tangible outcomes with clearer objectives.

**Table 4-1: Relationship of Issues and Approaches**

Issues	Approaches and Guiding Principles	Related Pilot Projects
1. Resource Management Policies, Plans, and Measures	Approach 1: Promotion of Effective and Sustainable Resource Management Policies, Plans and Measures	Pelagic Fishery Resource Development and Management
2. Diversification of Fisheries	Approach 2: Diversification and Improvement of Economic Efficiency of Fishing Activities	Pelagic Fishery Resource Development and Management
3. Fisheries Information	Approach 3: Improvement of Fisheries Information	Improvement of Fisheries Statistical Systems
4. Alternative Income Source	Approach 4: Development of Alternative Income Sources	Development of Low Cost Input Small-scale Aquaculture. Aquaculture Training and Extension
5. Marketing	Promotion of Species specific marketing activities (Included in other approaches)	Pelagic Fishery Resource Development and Management
6. Participatory Resource Management	Guiding Principle 1: Promotion of Participatory Resource Management and Development toward Co-management	All of the Pilot Projects
7. Regional Cooperation	Guiding Principle 2: Formation and Strengthening of Regional Network	All of the Pilot Projects

Note: Issues 2, 3, 4, and 6 are directly related to the S/W



**Figure 4-1: Guiding Principles and Approaches of the Master Plan**

This is a comprehensive approach to improve fisheries resource management with limited human and financial resources.

In order to achieve the short-term goal "Practical co-management models for sustainable use and management of the fisheries resources are established", it is necessary to include economic measures to encourage fishers to participate in resource management. The diversification and improvement of economic efficiency in fisheries as well as the development of alternative income sources are thus important approaches.

Improvement of fisheries information supports the resource management measures and plans by providing a continuous flow of reliable data and information. Provision of catch data by fishers and participating in monitoring activities would increase the awareness of fishers of the resource situation. This would directly contribute to the development of a co-management model. It also supports the diversification and improvement of economic efficiency in fisheries by providing relevant data.

In order to ensure effective implementation of the above four approaches, the guiding principle of participatory resource management becomes indispensable. The formation and strengthening of a regional network will enable member countries to share knowledge and technologies and implement research and development activities efficiently to progress with limited human and financial resources. The examples of activities for these approaches are

shown in Table 4-2.

**Table 4-2 Example of Activities for Each Approach**

<b>1. Example of Activities of Resource Management Measures</b>		
Fisheries Policy	Closed areas	<i>FAD usage monitoring and management</i>
Fisheries Management plan	Closed seasons	Stock enhancement
Fisheries Development Plan	Fishing gear limits	Habitat rehabilitation
Aquaculture Development Plan	Fishing size limits	Fishing gear modification
Marketing Plan	Allowable catch	
	Limited number of Fishing boats	
	<i>Entry limit</i>	
<b>2. Example of Activities of Diversification and Improvement Economic Efficiency of Fisheries □</b>		
	<i>Optimal utilization of medium and large migratory fish</i>	
	<i>Optimal utilization of diamond back squid</i>	
	Reef species	
	Fish processing and marketing	
<b>3. Example of Assessment of Fisheries Situations □</b>		
<i>Fisheries Statistics</i>	Stock assessment	<i>Communication and sensitization of fishers</i>
<i>Number of Fishing boats</i>	Visual survey	<i>Data supply by fishers</i>
<i>Number of Fishers</i>	Fishing survey	<i>Fishing boat registration</i>
<i>Landing by fish spp. by fishing methods</i>	Tagging survey	<i>Fishing licenses</i>
<i>Biological information</i>		<i>Stratification of fish landing sites</i>
<b>4. Development of Alternative Income Sources □</b>		
<i>Aquaculture</i>	Fish processing	
Agriculture	Handicrafts	
Tourism		
<i>Note 1: Words in italic is conducted in pilot project</i>		
<i>Note 2: Assessment of Fisheries Situation is an approach that provides information to other approaches.</i>		

### 4.3. Guiding Principles for Fisheries Resource Management

#### 4.3.1. Promotion of Participatory Resource Management and Development toward Co-management

Community participation is vital for coastal resource management in many countries including those in the Caribbean region. Fishery authorities usually enforce their fisheries regulations based on a long-term perspective which sometimes conflicts with the short-term interests of fishers. In such cases, fisheries regulations may not have the support and cooperation of fishers and are therefore more likely to fail. Community based resource management (CBRM) is now widely adapted to avoid such conflicts and improve overall coastal resource management. CBRM would not only encourage fishers to take long term responsibility of the fisheries resources they use, but could also be effectively incorporated within the fisheries policies of member countries such as CFP.

A typical way of CBRM implementation would include the following steps: 1) Planning CBRM reflecting both the issues and needs of the community and of the government; 2) Activating community participation in resource management activities and fostering community's ownership for resources; and 3) Establishing a resource management body consisting of both fisheries authority and the community. However, these steps may be challenging tasks.

The root cause of many issues affecting the coastal communities remains the difficulty in

integrating a long-term perspective for resource management with the fishers' short-term economic interests. This is the largest obstacle for a workable CBRM. In order to integrate fishers' short-term economic interests, alternative income sources should be selected reflecting conditions within each target community. For example, aquaculture or fish processing can be considered if the target site satisfies the correct environmental conditions and appropriate species are available for processing with a potential market. Fisheries related work could be the main alternative income source in a coastal community while other possible sources of income from tourism and other sectors also considered.

Another obstacle is the difficulty of attaining "collective actions toward management" among the fishers. While fisher's organizations have been developed to promote collective management actions in some countries, many fishers still act independently. In order to build good practices with CBRM, the existence of a functional fisher's organization is vital, especially at the initial stages of CBRM program introduction.

It is most feasible if the leaders of the fishers' organizations are concerned about the declining resources and are thus willing to improve the situation. Those leaders and the members of the organization who expend an effort in resource management activities would receive benefits equivalently. An organization which has only a specified type of membership would not be suitable for CBRM (i.e. cooperatives which consist only of boat owners). Also, organizations which do not represent certain coastal areas might provoke a conflict of interest among members from different groups. It is commonly observed that functional organizations for CBRM are deeply entrenched in the local communities and successfully ensure the participation of a large percentage of all types of local fishers. Since community organizations have wide-ranging histories and capabilities, a careful selection process is required. Once a community starts to participate in the planning of resource management, their awareness of the ownership of the resource can be promoted.

It is essential to understand the resource use patterns and the various levels of economic dependence the local communities have on these resources in order to avoid significant errors in the management of these resources, which in turn would lead to increased ecological destruction. Therefore, most of the recent monitoring activities contain not only biological information but also social and economic components. However, it is difficult to implement sustainable coastal resource management efficiently without proactive participation by the local community into the monitoring activities. It is indeed desirable to initiate monitoring activities by the local community with complementary biological monitoring conducted by a specialist. It is also necessary for the administrative agency to develop resource management measures from the information obtained from the monitoring activities and prepare appropriate regulations to support these activities.

The cooperation structures among local communities, research specialists and administrative agencies (Fisheries Departments) will enhance effective and sustainable resource

management.

#### **4.3.2. Formation and Strengthening of Regional Networks**

The research and development required to solve the issues pertaining to fishery resource management need to be carried out by the fishery authorities in each country. However, due to constraints of inadequate resources and skills faced by these agencies, it may be better to promote closer regional cooperation as a means of overcoming them. The importance of regional cooperation is highlighted with the following three points.

##### **1) Efficient use of Human and Financial Resources**

There are clear limitations in conducting research, studies, and training activities within individual CARICOM countries which possess both a small population and economy. Sharing knowledge and technologies will benefit member countries mutually and would enable limited resources to be utilized efficiently.

It is sensible to enhance regional cooperation in sharing knowledge and limited human resources as a means to achieving resource management efficiency. CRFM Secretariat has an important role to play in coordinating and promoting cooperation among member countries. Existing working groups of the CRFM, the Caribbean Network of Fisherfolk Organisations and other related groups could become the driving forces in regional cooperation within the various fisheries subsectors

##### **2) Regional Fisheries Management**

Effective resource management for highly migratory fisheries species would only be achievable if neighboring countries collaborate by sharing resource information and implementing harmonized conservation and management measures. The proposed resource management working group (mentioned in Chapters 5 and 6 of this document) activities would especially include information and data sharing on species shared among the member countries which will serve to benefit decision making appropriately.

CRFM will be responsible for coordinating the implementation of the conservation and resource management measures recommended by the working groups to achieve a harmonized and consistent implementation within the member countries.

##### **3) Regional Aquaculture Network**

In many member countries, the possibility of small-scale aquaculture (e.g. tilapia) has risen as an alternative income source for unemployed people due to the decline in traditional industries, such as sugarcane and bananas, and for local small-scale fishers who have been experiencing a continuous decline in fishery income. However, appropriate technologies that fit the needs of small-scale farmers and effective extension methodologies have not been developed. A regional aquaculture network could be established under CRFM to enhance

aquaculture development in the region. Its activities could include technical information sharing; development of an aquaculture policy; and formulating guidelines to protect the natural environment while being responsive to the socio-economic circumstances of each country.

#### **4.4. Approaches**

##### **4.4.1. Promotion of Effective and Sustainable Resource Management Policies, Plans and Measures**

If signs of depletion in aquatic resources or symptoms of deterioration of the habitat or environment are detected, it is then necessary to take countermeasures such as restrictions on existing fishing activities or establishing marine protected areas (MPAs). In most of the CRFM member countries, lobster and conch management measures have been in place for many years. Such measures include closed seasons, size limits, and total catch limits. Jamaica has all these measures but it is difficult to enforce the regulations, because the fishing grounds are far from the shore and fishers from other countries fish illegally. Belize is a good example of a country succeeding in establishing MPAs in collaboration with environmental NGOs and their fisheries department. The fisheries department controls the export of lobster and conch which is handled entirely by the fisheries cooperatives and as such the resources are well managed.

For the effective and sustainable resource management in the Caribbean, where the fisheries authorities suffer chronic shortage of resource, it is necessary for the fisheries authorities to improve policies, plans, and measures for resource management based on the information obtained through monitoring activities and also prepare appropriate regulations in support of these activities. For these reasons, cooperative arrangements among local communities, researchers from academic institutions, and fisheries authorities (fisheries departments) must be effective in accomplishing sustainable resource management.

Once depleted, fisheries resources usually take a long time to recover. To shorten this timeframe several resource recovery measures, such as seed stock releasing for species enhancement and the establishment of MPAs with the maintenance of habitat and nursery ground, have proven to be effective in some cases. The maintained habitat provides feeding and hiding places for juvenile fish and shellfish in the MPAs as well as raises the survival rates for several species. For example, juvenile Caribbean spiny lobsters (*Panulirus argus*) usually aggregate around concrete blocks located in shallow seagrass areas<sup>15</sup>. In Barbados, many individual juvenile Caribbean spiny lobsters were observed on structures within sea-moss aquaculture<sup>16</sup>. It may be possible for structures established in sea-moss culture to be simultaneously utilized as protected areas for juvenile lobsters. Thus the recovery of resources using activities outlined above for juvenile lobsters could become part of an overall co-management system with the support and involvement of the local communities, research

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<sup>15</sup> Cruz R, Adriano R., *Use of a fishery independent index to predict recruitment and catches of the spiny lobster*, 2004, NAGA, (World Fish Center), Quarterly, 27:27-30.

<sup>16</sup> Personal Communication with Colvin Taylor. Staff of Fisheries Division, Ministry of Agriculture and Rural Development, Barbados.

specialists, and administrative agencies. It is one of many possible resource management measures applicable to not only lobsters but also other fisheries resources.

#### **4.4.2. Diversification and Improvement of Economic Efficiency in Fisheries**

In order to achieve the sustainable use of fisheries resources, diversification of the local fishing industry into several activities which include offshore pelagic fishery and deep-sea fishing could be promoted.

It is preferable to introduce new fishery activities that do not require excessive investments for small-scale fishers and that have technically proven methods. In small islands where medium and large pelagic fishing are already popular, fishing operations are getting more expensive because the main fishing method is trolling which requires high fuel consumption. Since fish migrate near the shores of these islands seasonally and searching for a good fishing ground takes time, FAD fishing has become an important option for small-scale fishers to catch fish efficiently and prolong the fishing season. As a result, fishers are diverting excessive fishing pressure off reef and island shelf fishery resources, so as not to sacrifice any fishing income.

Appropriate fishery policies, plans, regulations, and monitoring programs as well as control schemes for new target species, such as the DBS or deep-sea fish, need to be carefully developed using the best available scientific information with a precautionary approach before starting full-scale fishing activities.

#### **4.4.3. Improvement of Fisheries Information**

It is vitally important to understand current fisheries resource usage and resource conditions to make sound fisheries policies in order to manage and develop the resources for sustainable use. The correlation of survey methods, information obtained, and resource management measures are summarized in Table 4-3.

The characteristics of each member country in the fisheries statistical system (FSS) are diverse. It would be better for the member countries to develop their own FSS; however, there are many difficulties in terms of human and financial resource limitations. During the first stage, since each member country is not able to deal with these issues using its own resources, it is necessary to categorize the member countries into groups with similar characteristics, and establish and develop FSS models for each group. The following groups are suggested.

**Group A:** has developed their own FSSs using existing resources. This group is able to continue to enhance their own FSS. CRFM may share information among the CARICOM member countries and present the results of pilot projects to the group as reference information. Some specific training sessions on stock assessments, regional database policies, and procedures may be required.

**Group B:** requires the development of the FSS model during the first stage. Member countries belonging to Group B should review and revise their data collection

systems as well as their data management systems. After the FSS is adapted the member country may customize it according to its needs.

**Group C:** experiences a variety of difficulties which require considerable efforts to overcome. This group needs to explore the possibilities to utilize external resources such as industry companies and fishers' cooperatives as well as other governmental agencies. Some member countries already have a well-developed collaborative system. Such good practices can be applied in other member countries in this group. This group needs to consider complete overhaul of and/or re-development of fishery statistics systems. Since sufficient feedback of the obtained data is not currently undertaken in group C countries, it is difficult to have cooperation from stakeholders for data collection. It will also be required to strengthen relationships among the stakeholders and to provide regular feedback of the fishery data to the relevant organizations and local fishers.

Considering the issues and constraints of FSS in the Caribbean, the following activities need to be undertaken in order to establish an appropriate FSS.

- Develop the FSS model including a sampling program, data management and administration, vessel and fisher registration, and information dissemination corresponding to the characteristics of each group, especially the groups "B" and "C."
- Review and, where necessary, customize the proposed FSS model to meet the needs of the identified member country and implement it. Additionally, monitoring systems need to be developed and strengthened for each member country.
- Define any other necessary fishery data such as biological data, socioeconomic data of fisheries workers, export and import data, and recreational fishery data corresponding to the needs of each member country and design an implementation structure for the collection of the defined data. Table 4-2 shows the relationship among survey methods, the information obtained and implications for resource management measures.
- Review the current data analysis methods, and establish new appropriate data analysis methods corresponding to the needs of each member country.
- Strengthen the logistics of data management and administration for each member country.
- Develop training manuals for statistical officers, data managers, data operators, data collectors and fishers. Training activities using the manuals must be included in annual activities for each member country.



- Enhance awareness programs with fishers about fishery data collection and resource management.

**Table 4-3: Relationship among Survey Methods, Information Obtained and Resource Management Measures**

Relationship between resource management measures and necessary survey											
Basic information											
	Number of fishing boats by size and fishing method										
	Number of fishers										
					Relationship between main resource management measures and survey type						
	Survey/research item	Expected survey Frequency	Expected information	Possible Diagnosis of resources	Total allowable catch	Closed season	Closed or protected areas	Minimum size limits	Fishing gear restrictions	Limited entry (fishing boats)	
Fish landing information	Monthly Landing Amount per fishing method and fish species	Every month and continuous	Fishing season (migration period), yearly trend of the catch by species	If the catch is declining year by year, the resource is considered to be declining. The reasons for migration may be identified by analyzing the patterns that relate to water temperature, precipitation, fishing grounds, and differences in fishing methods.	○	○	○		○	○	
	Monthly CPUE per fishing method and fish species	Every month and continuous	Fishing season (migration period), yearly trend of CPUE	If the CPUE is declining, the resource may be considered to be declining as well. However, the decline may be due to a large increase of fishing boats and fishers.	○	○	○		○	○	
Biological/ecological information for important species	Body length frequency	Every month and continuous	Yearly trend of length frequency, estimation of monthly growth, estimation of recruitment amount (if the fish size is not biased by fishing method)	If the length of the fish have tendency to be shorter year to year, the fishing pressure on the resource may be excessive. If the sample were collected randomly, the size frequency could be separated into different age stocks and thus the growth and recruitment could be estimated.	○	○	○		○	○	
	Body weight and length	Every month for one year	Length and weight relationship, estimation of the gonad weight and spawning season	When the weight keeps increasing and then suddenly declines for the same fish, it is reasonable to consider that this is due to spawning. Resource conditions will not be obtained with this information.		○		○			
	Gonad weight and maturity	Every month for one year	Size of maturation and spawning season	The maturation size and spawning period is revealed. Resource conditions will not be obtained through this information over the period of a single year. If the maturation size becomes smaller when the same survey is conducted in subsequent years, it can be assumed that the resource is under fishing pressure.		○		○	○		
	Age determination by otolith or scale	Every month for one year	Estimation of the size and age relationship and growth rate	The length and age relationship is determined, and the yearly growth rate is estimated. Resource conditions will not be obtained through the use of this information.				○	○		
	Tagging	Limited period	Growth rate and migration route	Growth and migration routes are determined for individual fish. Resources conditions will not be obtained through the use of this information.		○	○				

#### **4.4.4. Development of Alternative Income Sources**

To achieve sustainable development in coastal communities, the sustainable use of fisheries resources is one key activity but other alternative income generating activities are also needed to keep up with the increasing number of community members. Development of alternative income is important to address the effects of climate change and to build resilient communities. Agriculture, animal husbandry, small industry, and tourism are possible alternative directions for some communities. However, in terms of alternative income sources within the fisheries sector, aquaculture and fish processing could be easily accepted and viable options for fishing communities. Among these two options, development of fish processing may face initial difficulties since suitable methods of fish processing varies depending on the type of species available and acceptability of processed product in the local market needs to be carefully examined. On the other hand, aquaculture does not seem to have such initial difficulties and hence have higher applicability for most countries in the region.

With the exception of Guyana, Suriname, and Trinidad and Tobago, most Caribbean countries face an inadequate supply of fish for local and tourism markets. Demand for low-price species such as tilapia is high in the CARICOM member countries. Although tilapia aquaculture has already been implemented in some member countries, it is industrial style aquaculture in most cases, and the development of community-based small-scale aquaculture has not been properly researched or promoted.

One of the major bottlenecks constraining the development of community-based small-scale aquaculture in the region is the high cost of artificial feed, which increases the production cost. The feasibility of sustainable small-scale tilapia aquaculture should be tested and verified. Information regarding these activities has not been well disseminated at the regional level. To develop small-scale aquaculture in the Caribbean, it is vital to reduce feeding costs to achieve an improvement in the profitability of aquaculture businesses.

Another reason for the slow development of small-scale aquaculture is the use of inappropriate culture techniques and extension methodologies. Most of the techniques are for large-scale and input intensive types of aquaculture and are not designed for family-based small aquaculture farms. Feed, water, predation and other pond management issues are not the same as larger farm ponds and the environment differs from farm to farm. Therefore, it is necessary to develop appropriate technologies for small-scale aquaculture training and extension activities.

To verify the efficacy of guiding principles and approaches in fisheries management mentioned above, several ideas for pilot projects were formulated and implemented. Lessons learned from the implementation of the pilot projects will be utilized to formulate a master plan for small scale aquaculture development.

## **5. Plan for the Sustainable Use of Fisheries Resources on Coastal Community Development**

### **5.1. Composition of Development and Management Plans**

Two guiding principles and four approaches were introduced in Chapter 4. Through the implementation of the pilot projects, these guiding principles were found reasonable and the approaches were verified to be effective.

Participatory resource management, one of the guiding principles, was found essential for sustainable resource use, data collection, and even aquaculture development. Participatory resource management principle is thus undertaken and explained in respective approaches.

The other guiding principle, i.e., functional regional networks, was developed into a framework for regional cooperation based on CRFM working groups' activities and was presented in the next section.

The four approaches were further refined, and detailed activities were introduced in accordance with the characteristics of each approach. However, Approach 1, "Implementation of Resource Management Measures," and Approach 2, "Diversification and improvement of economic efficiency of fisheries," are combined and discussed in section 5-3, because the realization of the importance of comprehensive implementation of resource management activities. Fishers need to be shown clear benefit and incentives to participate in resource management measures.

### **5.2. Regional Network**

#### **5.2.1. Changing the Communication Mode**

Traveling is both time and budget consuming in the Caribbean. It needs to be reduced and day-to-day communication with member countries enhanced. Each unit of the CRFM Secretariat must take more responsibility for its communication and consultation. The most effective communication platform is the Internet that enables the use of e-mail and online meetings. High-speed Internet connection and large monitors for online meetings are needed. Also, the Secretariat staff members need to facilitate improved communication among working group members. Some of the working group members may have knowledge and experience to provide solutions for other members.

Besides day-to-day communication and consultation, working groups should organize meetings with relevant themes such as practical co-management methods, feed development for aquaculture, and regional database.

With the above in mind, a review of the Secretariat as part of CRFM should be undertaken so that its role, functions and structure can be refined. Also, a comprehensive communication strategy and plan should be prepared.

### **5.2.2. Mobilization of Regional Experts**

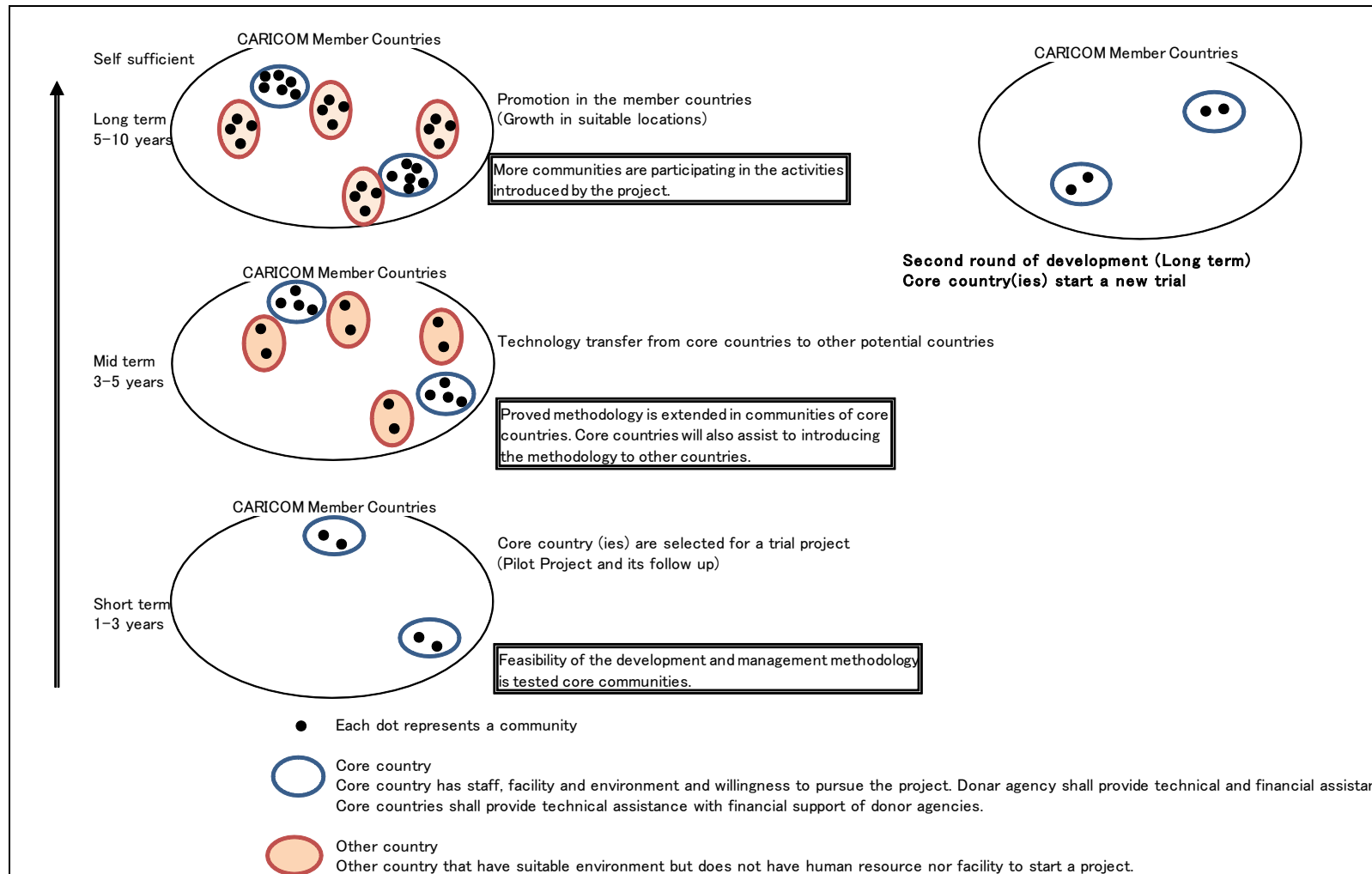
In the Caribbean region, there are people with expert knowledge in certain aspects of fisheries. As mentioned in the section 5.1.4, sub-sector-based working groups should be formed with these experts and the staff of the national fisheries offices and the CRFM Secretariat. Experts shall include the staff of regional academic and specialty institutions such as UWI and CFTDI so that the needs of the member countries are reflected in the activities of these institutions. The CRFM Secretariat will need budgetary support from international donors as well as within the region. Communication should be mainly through the Internet. Fisheries authorities of core countries and regional and national institutions related to fisheries research and development, such as UWI, CNFO, CFTDI, and IMA, could conduct workshops and other training activities that are proposed by the working group above. These workshops should focus on fishers as well as fisheries officers and should be done through online meeting facilities as much as possible. The working group should be a model for regional development and fisheries extension. A regional skills bank of persons from fisheries authorities and academic institutions with expertise in fisheries and related areas should be established and maintained by CRFM.

### **5.2.3. Responding to the Needs of an Individual Country**

Improvement in communication by mobilizing regional experts through the working group above will be a key to addressing the needs of an individual country. Although the CARICOM member countries differ in characteristics, the experience of one country may prove useful in another. Once the subsector group has worked on the problem, a visit by a working group member may help solve it.

### **5.2.4. Developmental Trials through Core Countries**

Those member countries that have a favorable environment and possess facilities and experts to pursue certain developmental trials have a better chance to succeed in specific issues compared to others. With technical support by CRFM, the chance for success would be even greater. The implementation of six pilot projects has revealed that the host countries are eager to share their knowledge and technologies with other CARICOM member countries. Sharing the experiences of spearhead countries (core countries) in the following steps would be an efficient way to utilize the limited resources in the region and the donor agencies' diminishing support: (1) the development model helps the core countries succeed in a pilot first; and then (2) the core countries assist other countries to implement similar projects. Meanwhile, the core countries extend the success to the entire region in the mid-term. The model is shown in Figure 5-1.



**Figure 5-1 Regional Development Model through Core Country Initiation**

### **5.2.5. Working Group of CRFM Secretariat**

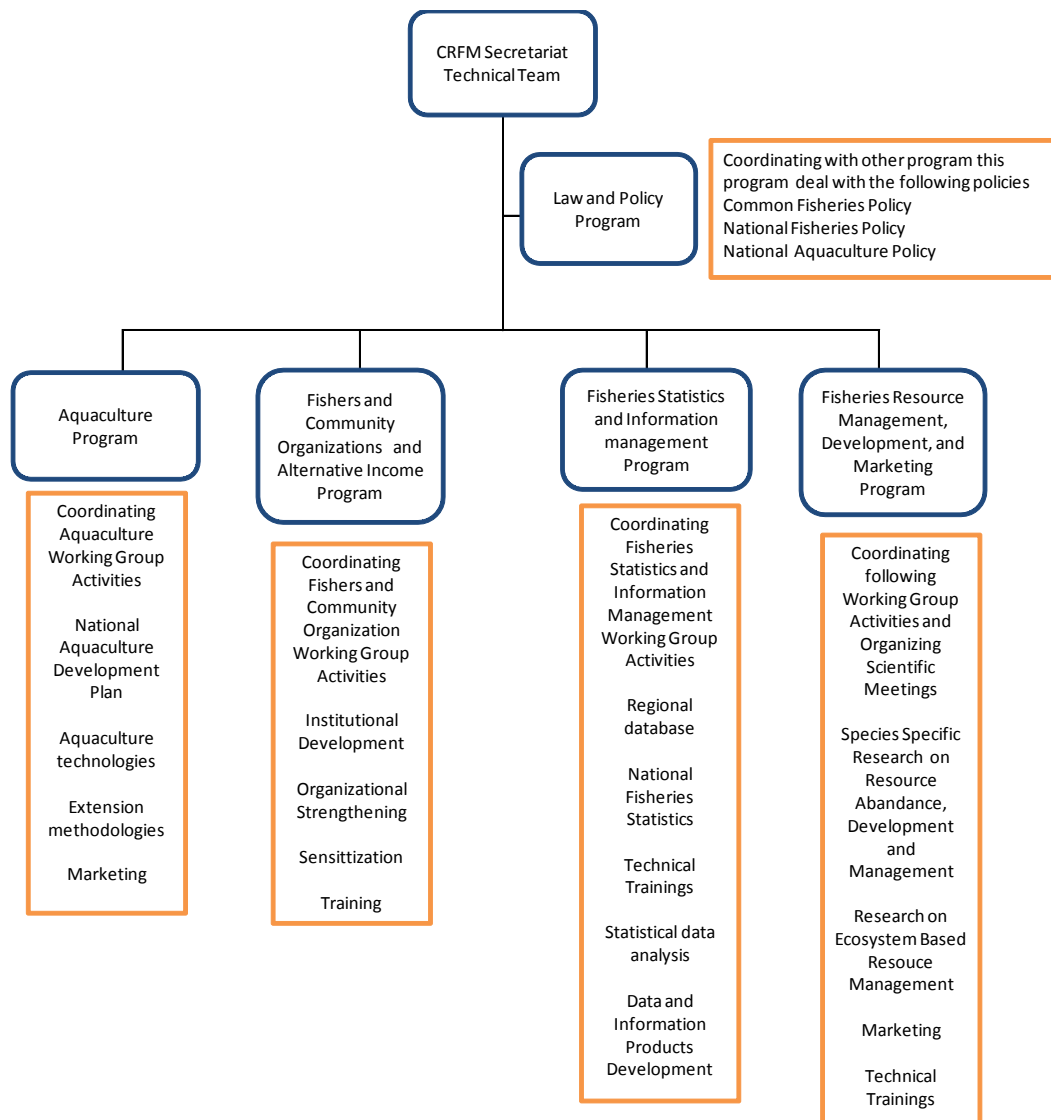
In order to realize the recommendations above, working groups will play a vital role in selected programs. A program is a long-term plan consisting of several activities. Working group will decide activities in line with the purpose of the program. Working group members will discuss issues from a technical viewpoint and undertake the groundwork within the program while the chief fisheries officers provide feedback. Chief fisheries officers will then be able to make policy recommendations to policy makers with better information. The working group may create a sub-working group if necessary. The CRFM Secretariat will act as the coordinating office for various working groups.

Working group activities will be a major focus of the CRFM's programs. The current working groups under the Research and Resource Assessment Program shall continue their activities, but CRFM will take a step further to include resource management at the national and regional levels. This program may be renamed the Fisheries Resource Management, Development, and Marketing Program and the CRFM Secretariat will coordinate the working group. The Secretariat will be responsible for coordinating species specific research on resource abundance, development, management, and marketing, and organize an annual meeting. It will take an ecosystem-based resource management approach for interspecies and wider environmental consideration. It will also coordinate technical training for individuals at the national and regional levels. In addition, it will undertake the following:

- Coordinate a working group of the Fisheries Statistics and Information Management Program.
- Be responsible for development of the regional data base as well as improving national fisheries statistics through technical assistance and trainings.
- Be responsible for publications.
- Coordinate a working group of the Fishers and Community Organizations and Alternative Income Program.
- Be responsible for institutional development and strengthening of national and regional fishers' organizations by way of technical assistance and training. Training may include alternative income other than fisheries sector such as tourism, handicraft and agriculture.
- Be responsible for sensitization of coastal communities and the public in fisheries resource management and development.
- Coordinate the aquaculture working group and be responsible for the development and implementation of national and regional aquaculture development plans.
- Provide aquaculture technologies and extension methodologies as well as marketing through technical assistance and training for member countries.

- Coordinate the Law and Policy Program.
- Assist in the development and implementation of national fisheries and aquaculture policies that are in line with the CFP.

Figure 5-2 shows the proposed CRFM technical service programs.



**Figure 5-2 Proposed CRFM Technical Service Programs**

Any CRFM member country can join a working group on a voluntary basis. Moreover, any CRFM observer organization is eligible to be a working group member. Regional and national institutions such as UWI, CNFO, CFTDI, IMA would be encouraged to become members. The chair of the working group will be selected from its members and will manage the group with the person responsible for the group at the CRFM Secretariat. The Fishers and Community Organization working group would naturally include leaders of the fishers and community



organizations. It is also suggested that similar working groups be established in each national fisheries administration to ensure the participation of stakeholders. Figure 5-3 shows the role of the working group and the information and data flow.

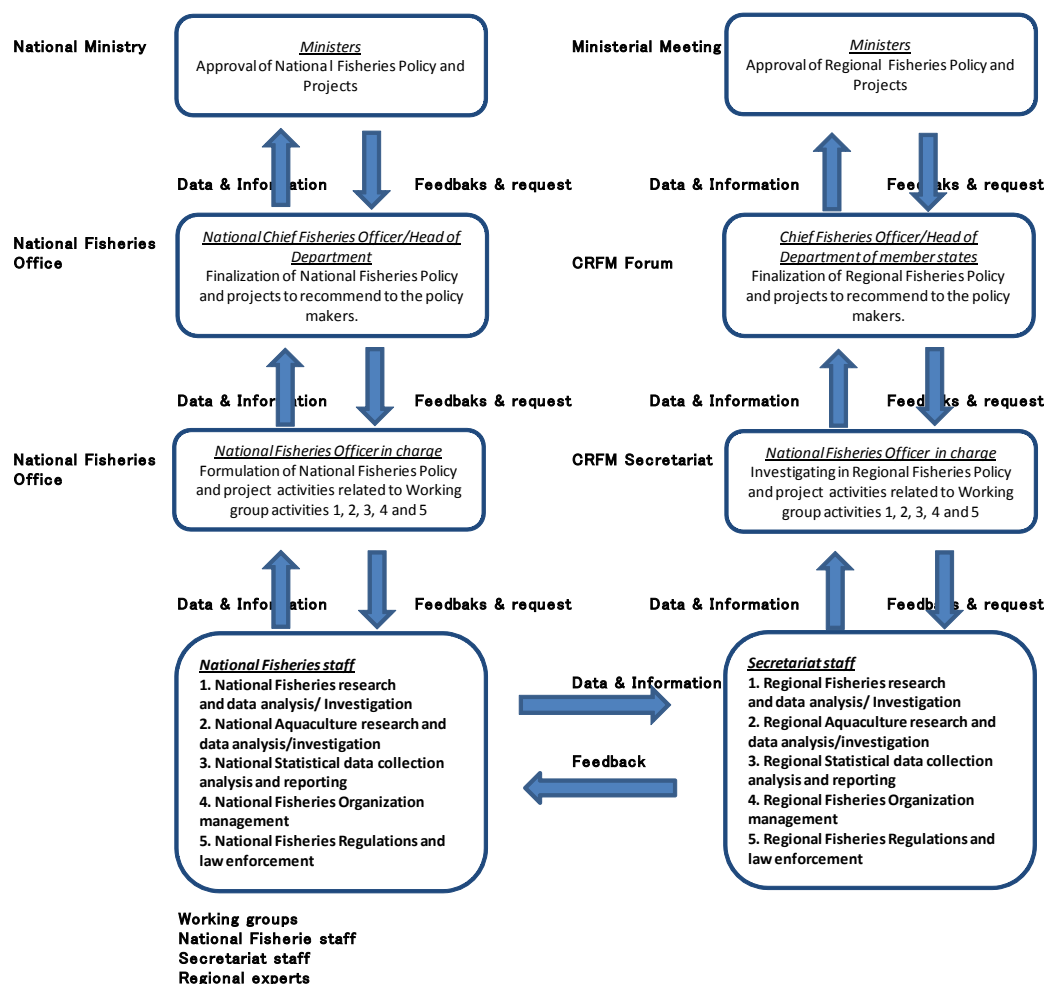


Figure 5-3 Role of Working Group and Data and Information Flow

### 5.3. Small-scale Fisheries Resources Management and Development

#### 5.3.1. Background of the Plan

In Dominica and St. Lucia, the FAD fisheries have an important role to shift small-scale fishers from coastal to offshore resources with sustainable economic profit. Therefore, promoting the diversification of fisheries with sustainable economic profit utilizing under-exploited and un-exploited ocean pelagic resources through the use of FAD fishing could become a significant means of diversification, once the under-exploited and un-exploited resources have been clearly identified and the co-management arrangements developed.

CFP includes the following statement: *“The Participating Parties: Conscious that there exists within the jurisdiction of Participating Parties underexploited or unexploited fisheries resources of great value which represent a safeguard for the future development of fisheries and, when used sustainably, present an opportunity to increase the contribution of fisheries to the social and economic development of the Caribbean Community”*

Through the implementation of pilot projects in FAD and associated pelagic fishery resource development and management in Dominica and St. Lucia, participatory community-based monitoring and management of FAD fishery and associated pelagic resources have been verified, and the results highlight some key elements of this co-management approach. They are not only useful FADs but also other fishery management tools such as the maintenance of habitat and nursery ground, MPAs, and some regulations which are appropriate and could better be accepted, and managed together with small-scale fishers and their organizations. As a result of the pilot project, a draft FAD fishery co-management plan was produced, reflecting practical and necessary activities such as technology development, data collection, licensing, regulation, fund generation, and sensitization activities. The working draft plan emphasizes the need to take into account all comprehensive activities for participatory community based resource management. Workable approaches in FAD fishery co-management plans in Dominica and St. Lucia could be utilized in other countries in the region, which have a similar fisheries structure and keen interest in pelagic fishery management by utilizing FADs. However, successful introduction in the beneficiary countries requires creation of a customized, detailed, and comprehensive FAD fishery management plan that is modified in view of practical situations in the respective countries. In addition to FAD fishery co-management for large pelagic fish, the introduction of other fishery co-management models for reef and coastal demersal (slope) fish, lobster and conch, shrimp and ground fish, small pelagic fish, and un-utilized resources needs to be considered to solve the issues within small-scale fisheries. Community participatory fishery resource management also needs to be adapted in fishing ground rehabilitation utilizing the following means, among others: the maintenance of habitat and nursery ground for reef and demersal fish; countermeasures against ghost fishing by pot fishery for reef and demersal fish; coastal small pelagic resource and environment monitoring utilizing modified seine net fishery and set net fishery; and unutilized diamondback squid resource development.

In order to develop and promote co-management models in the region, the formulation of working groups for promotion of models in each country comprising key stakeholders is indispensable, as is the formulation of CRFM working groups under the Fisheries Resources Management and Development Program of the CRFM Secretariat Technical Team.

### **5.3.2. Scope of the Plan**

In order to develop and promote small-scale fisheries resource co-management models and systems in the region, the following timeframe, purpose, and outcomes are planned (Table 5-1).

**Table 5-1: Scope of the Plan for Small-scale Fisheries Management and Development**

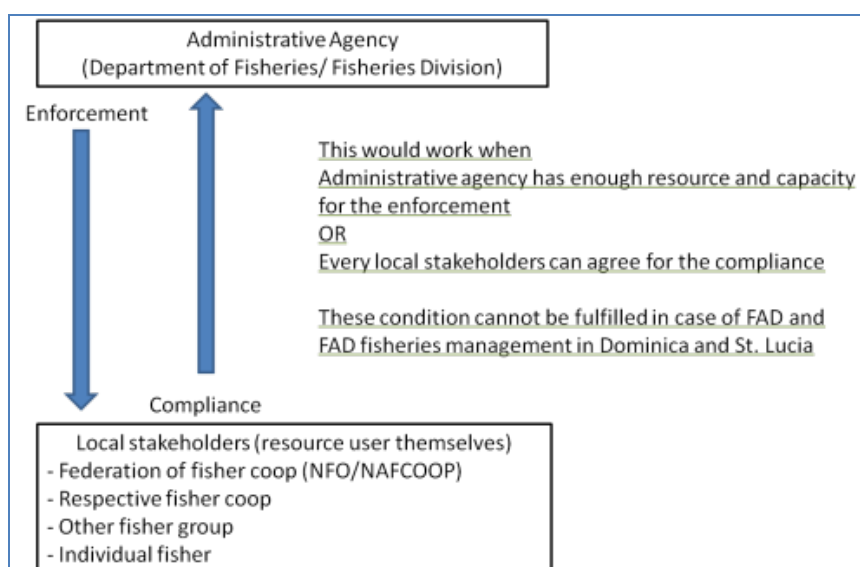
Term	Purpose	Outcome	Impact
Long term (10 yrs)	Management measures for sustainable use of small-scale fisheries resources are efficiently promoted in member countries through the use of small-scale fisheries resources management and development working groups with a co-management approach	<ol style="list-style-type: none"> <li>1. Dependency of small-scale fishers on the overexploited coastal and reef resources is reduced through diversification and economic improvement of fishing operations.</li> <li>2. Co-management of small-scale fisheries resources among fishers/fishers' organizations and fisheries department/division becomes common</li> </ol>	Stable and improved livelihood for local fishers is promoted
Medium term (5 yrs)	Efficient resource management measures developed and implemented through the use of small-scale fisheries resources management and development working groups using a co-management approach	<ol style="list-style-type: none"> <li>1. Co-management system to achieve sustainable use of fisheries resources for small-scale fishers is developed and the necessary technologies, knowledge, and experiences are shared in the region</li> <li>2. The role and activities of regional resource management systems including networks are enhanced</li> </ol>	
Short term (2-3 yrs)	Co-management models to achieve sustainable use of fisheries resources for small-scale fishers are developed and the necessary technologies, knowledge, and experiences are shared in the region through the working group	<ol style="list-style-type: none"> <li>1. The practical co-management models for managing fisheries resources in collaboration with fisheries authorities and local fishers/ fishers' organizations are evaluated and strengthened</li> <li>2. The CRFM small-scale fisheries resource management and development working groups are established and a working group in each member country is also established and developed</li> </ol>	

### 5.3.3. Management Structure of Activities

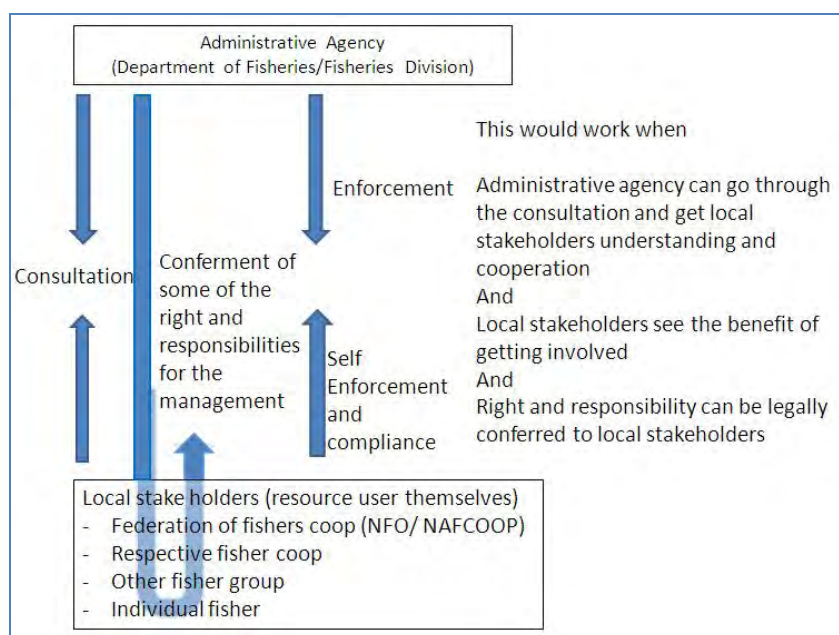
#### 5.3.3.1. Management by Fisher Organizations, Co-management

Small-scale fisheries have a strong linkage with fishing communities, and normally target multiple species using several types of fishing gear, depending on seasons and climate conditions. The nature of small-scale fisheries in the region differs from that of commercial large-scale fisheries in developed countries. An administrative top-down approach utilizing techniques such as quotas on catches of fish species based on stock assessment is suitable for commercial scale fisheries resource management in developed countries with strong enforcement powers and sufficient administrative human, institutional, and financial resources. However, a bottom-up approach through co-management is required for small-scale fisheries resources management and development in most CARICOM countries, which possess small fisheries administrations with limited human, institutional, and financial resources (Figure 5-4).

### *Top-Down Approach*



### *Bottom-Up Approach*



**Figure 5-4: Two Approaches to Reach Communities**

The implementation of the pilot project in Dominica and St. Lucia proved that a bottom-up approach was a preferable and practical management measure. Fisheries administrators have responsibility for national fisheries resource protection and management, and involvement from people who use the resources daily is a key element to take proper management decisions. Therefore, co-management by fisheries administrators in collaboration with fishers and/or fisher organizations, in a participatory community-based management style, should be the basis for small-scale fisheries resource management and development in the region. During the short term of the fisheries resource management and development program, the existing

co-management model, such as the FAD fishery co-management program, including DBS development, and marketing in core countries, will be evaluated and strengthened. Then, the new co-management program, such as the maintenance of habitat and nursery ground where appropriate, and other programs aimed at resource enhancement, rehabilitation and management, will be formulated and implemented in other core countries. The experiences of the first co-management model will be utilized during the formulation and implementation phase of the second co-management model. During the medium term, the first and the second co-management models will be extended from the core countries to other potential countries, and the third and fourth co-management models will be formulated and implemented in other core countries. During the long term, this cycle will be extended to other co-management models and other potential countries. Basically, each target country will take responsibility for program planning and operation within its own borders, and the CRFM Secretariat in collaboration with each core country will facilitate an extension of the program to other member countries.

#### **5.3.3.2. Regional Cooperation and Role of the Working Group**

The result of the pilot project in Dominica and St. Lucia clearly shows that DBS fishery development and marketing activities have been promoted from the initial stages by the DBS working group comprised of key stakeholders. This working group gave members opportunities to deliberate and work together and clarified each member's responsibilities. Activities helped to pool experiences, knowledge, and skills from each member to be utilized for improvement. As a result of sharing, improvements of FAD fishery co-management, technology, and extension methodology were accelerated in each country. These experiences can also be utilized in national-and regional-level cooperation. The core countries and voluntary member countries, who have been promoting or are eager to promote small-scale fishery co-management models, can formulate CRFM working groups, such as a large pelagic fish working group for FAD fishery co-management. The expertise available in the national fisheries department and the fisher folk organizations in each country, CRFM, UWI, CFTDI, and other regional or national institutions can be jointly utilized for enhancing intra-regional cooperation, extension services, and technical assistance to the CARICOM countries. Moreover, useful human resources and programs in each country should be surveyed and then utilized within member countries of CARICOM. This coordination should be an important role of CRFM. Under the fisheries resource management, development and marketing program, the following issues should be discussed at the working group meetings from technical and policy viewpoints with national and regional consideration (Table 5-2). These issues will be discussed in accordance with the priority set among the working group of the program.

In order to promote a co-management model for small-scale fisheries resource management and development in each country, it is indispensable that each member of the CRFM working group formulate a country-specific working group comprising of stakeholders such as key

fisheries officers, key fishers, and key persons within fisher organizations, at the national level as the first step. Through workshops, meetings, and discussions, the CRFM working group members can share their information, knowledge, and experiences and accelerate the activities in each country.

**Table 5-2: Working Groups under Resource Management, Development and Marketing Program**

No.	Issues	Expected discussion theme
1	Large pelagic fish	FAD fishery co-management, non-popular fish utilization, basic fishermen training, four stroke engine promotion, promotion of micro finance for FAD, rehabilitation of existing fisheries center, etc.
2	Small pelagic fish	Small pelagic fish monitoring utilizing modified seine net fishing or set net fishing, etc.
3	Reef and slope fish	Reef rehabilitation and management, ghost fishing prevention for pot fishing, etc.
4	Un-utilized resources	Diamondback squid fishery development, and sea cucumber resource survey, etc.
5	Lobster and conch	Lobster nursery ground rehabilitation, conch nursery fishing ground rehabilitation, stock enhancement, etc.
6	Shrimp and ground fish	Bottom trawl fishing modified data collection, etc.

#### **5.3.4. Activities of Short-, Medium-, and Long-Term plans**

##### **5.3.4.1. Short-Term Plan**

The following are the activities in the short-term plan.

Output 1: The practical co-management model for managing fisheries resources in collaboration with fisheries authorities and local fishers/fishers' organizations is evaluated and strengthened as preparations for promotion in the region.

Activities for Output 1

1-1 Strengthen the existing FAD fishery co-management program, including DBS fishery development, and marketing in the core countries for promotion in the region.

1-1-1 Conduct further research and development of the existing FAD fishery co-management program in the core countries.

1-1-2 Conduct further DBS fishery development and marketing in the core countries.

1-1-3 Monitor and evaluate Activities 1-1 for Output 1.

1-2 Develop other new useful community-based programs aimed at resource enhancement, reef fisheries rehabilitation and management, from needs for co-management of resources in the region. Such programs may include the construction, maintenance of habitat and nursery ground.

1-2-1 Survey other useful programs, which are to become community-based programs, in the region.

1-2-2 Select other new useful community-based programs, such as the maintenance of

habitat and nursery ground, where appropriate, and other core countries from needs for co-management of resources in the region.

1-2-3 Implement other new useful community-based programs, such as the maintenance of habitat and nursery ground management, where appropriate, in the other core countries.

1-2-4 Monitor and evaluate Activities 1-2 for Output 1.

Output 2: The CRFM small-scale fisheries co-management working group is established and developed, and a working group in each member country is also established and developed.

Activities for Output 2

2-1 Highlight the co-management within CRFM large pelagic working group

2-1-1 Establish discussion of co-management within the large pelagic working group.

2-1-2 Conduct regular (internet) meetings.

2-1-3 Conduct study tour activity by the working group in the core country.

2-1-4 Monitor and evaluate Activities 2-1 for Output 2.

2-2 Establish and develop a working group in each member country.

2-2-1 Hold meetings and a series of discussions with key stakeholders in each member country.

2-2-2 Establish a FAD fishery co-management working group in each member country.

2-2-3 Make an action plan for a FAD fishery co-management working group in each member country.

2-2-4 Monitor and evaluate Activities 2-2 for Output 2.

#### **5.3.4.2. Medium-Term Plan**

Here are the activities in the medium-term plan.

Output 1: A co-management system to achieve sustainable use of fisheries resources for small-scale fishers is developed and the necessary technologies, knowledge, and experiences are shared within the region.

Activities for Output 1

1-1 Promote the existing FAD fishery co-management program, including DBS development and marketing, from the core countries to the member countries in the region.

1-1-1 Conduct workshops in core countries.

1-1-2 Conduct workshops in other member countries.

- 1-1-3 Conduct sensitization activity in working group member countries.
- 1-1-4 Establish a FAD fishery co-management body in working group member countries.
- 1-1-5 Monitor and evaluate Activities 1-1 for Output 1.

1-2 Promote other new useful community-based programs aimed at resource enhancement, reef rehabilitation and management, from the core countries to the member countries in the region. These programs may include the maintenance of habitat and nursery ground where appropriate.

- 1-2-1 Conduct workshops in the core countries.
- 1-2-2 Conduct workshops in other member countries.
- 1-2-3 Conduct a sensitization activity in working group member countries.
- 1-2-4 Establish co-management bodies for other new useful programs in working group member countries.
- 1-2-5 Monitor and evaluate Activities 1-2 for Output 1.

Output 2: The role and activities of regional resource management systems including networks are enhanced and functional.

Activities for Output 2

- 2-1 Conduct regular meetings for each working group.
- 2-2 Organize technical consultation system for the member countries.
- 2-3 Prepare an annual work plan for each working group.
- 2-4 Coordinate regional and individual country training in accordance with the annual work plan.
- 2-5 Conduct a sensitization activity at the national level.
- 2-6 Monitor and evaluate the activities for Output 2.

#### **5.3.4.3. Long-Term Plan**

The activities in the long-term plan are as follows.

Output 1: Dependency of small-scale fishers on the overexploited coastal and reef resources is reduced through diversification and economic improvement of fishing operation.

Activities for Output 1

- 1-1 Promote the verified co-management programs from the core countries to the other member countries in the region.
- 1-2 Develop further useful community-based programs in other core countries to the member countries in the region.
- 1-3 Monitor and evaluate the activities for Output 1.



Output 2: Co-management of small-scale fisheries resources among fishers/fishers' organizations and fisheries department/division becomes common.

#### Activities for Output 2

2-1 Promote exchange of information and knowledge among small-scale fisheries management organizations in the region through CRFM working group.

2-2 Promote exchange of information and knowledge between the Caribbean and other regions.

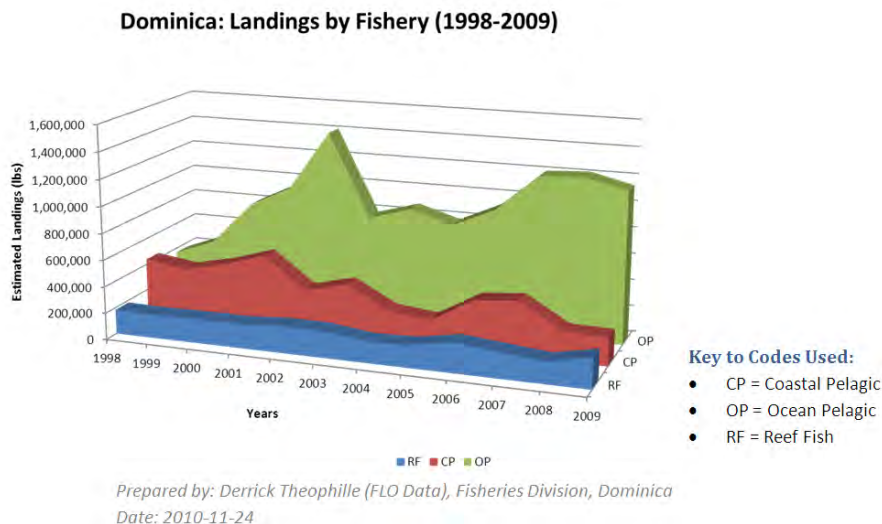
2-3 Conduct a sensitization activity at the regional level.

2-4 Monitor and evaluate the activities for Output 2.

### 5.3.5. Detailed Activities for Working Groups

#### 5.3.5.1. FAD Fisheries Development and Management

FAD fishery has become one of the main types of fisheries in Dominica and St. Lucia. Both statistical data and landings by fishery in Dominica show that, since the introduction and development of FAD fishery in Dominica in the early 1990s, ocean pelagic species landings have increased and exceeded coastal pelagic and reef species landings after 1998, while landings of reef fish have maintained stability (Figure 5-5). Thus the development of under-utilized ocean pelagic species through the utilization of FAD has contributed to the easing of fishing pressure on reef fish.



**Figure 5-5: Dominica Fish Landing Trend by Fishery Category**

It is important for resource management to understand catch trend of each fishery (ocean pelagic, coastal pelagic, and reef fish) and to obtain a certain indicator for resource management through biological data collection for target species (dolphin fish and yellow fin tuna), in order to obtain size trend. Biological data collection of target species needs to be continued at selected

landing sites where the data collectors have the cooperation of fishers. Minimum sampling numbers should be kept and sustainability of biological data collection needs to be prioritized within the activities of fisheries department/division. It should also be continued at least in the medium term. In addition, biological data collection for main target species of reef, coastal demersal species, and coastal pelagic species should be considered in the future.

Fishers believe that modified FADs using mid-water buoys enable fish aggregation even if damage is sustained, because the buoys remain in mid water layers. Further research and development of FAD technology is anticipated in both Dominica and St. Lucia. This FAD technology development in both countries will be directly utilized in other countries in the region that plan to introduce or promote FAD fishery using locally available materials efficiently and economically.

Also, in both countries, the fisheries administrative agency and the fishers/fisher organizations are working toward a stable, profitable, and sustainable FAD fishery, which is diversified in fishing operations with available species. This fisheries co-management model utilizing FADs targets ocean pelagic species, which migrate along the islands in the region, and therefore highlights the role of CRFM. Through the activities of CRFM large pelagic fish working group for FAD fishery co-management, the FAD fishery co-management model should be promoted in other countries in the region, utilizing useful human resources such as the fishers, the fisher cooperative staff, and the fisheries officers in the core countries, in collaboration with regional and national institutes, such as UWI, CNFO, and CFTDI.

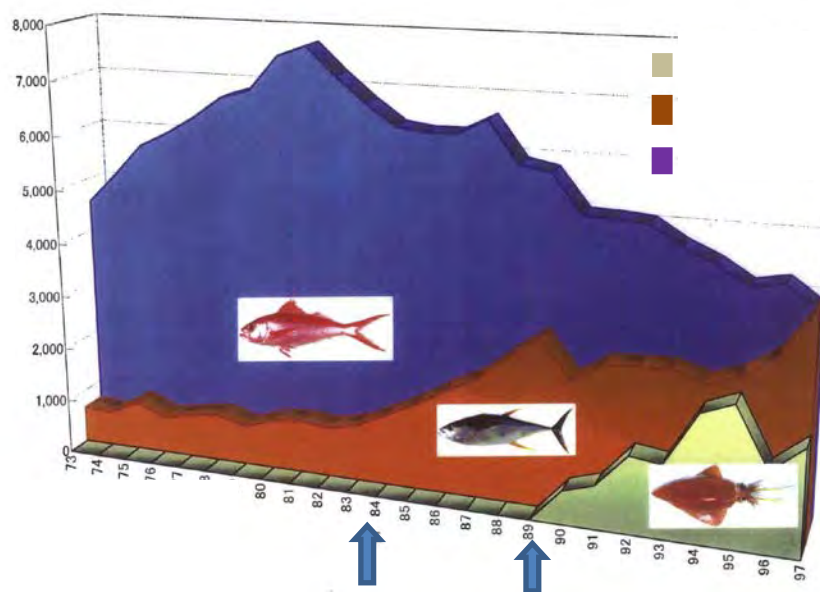
#### **5.3.5.2. DBS Fishery Development and Marketing**

DBS fishery development and marketing has just begun in Dominica and St. Lucia. The experimental market price of DBS, which targeted tourist restaurants and hotels in a niche market, has sufficiently attracted the attention of fishers. In the initial stage of working with an under-utilized resource in development and marketing, it is very important to develop even small but viable markets in the local area. The catch amount of DBS is low due to the limited experimental fishing opportunities by the working group, although the amount is constant. Biological data as well as catch data have been recorded and will be valuable for DBS fishery resource management in the future. After the completion of one year's experimental fishing by the DBS working group, DBS fishery will be conducted by fishers in Dominica and St. Lucia. Once it is in full-scale, the amount of catch will steadily increase. To emphasize further market development in the future, a DBS recipe book targeting local restaurants is being prepared in Dominica in collaboration with JICA experts.

Fishing gear for DBS fishery is expensive because it has to be imported from Japan. One of the activities in Dominica is to develop and test locally available materials for DBS gear. In St. Lucia during the second stage, DBS fishing at night is planned using DBS modified fishing gear to increase fishing efficiency. It is known that DBS inhabit shallow waters at the depth between

0 and 100 m at night, while inhabiting 400-600 m deeper waters during the day. It is planned to develop DBS fishing just around FADs, so that FAD fishers can have the option of using DBS fishing gear during the DBS fishing season.

The experience of DBS fishery development and marketing in Dominica and St. Lucia will be adapted and utilized in other island countries in the region, which have similar environmental and socio-economic conditions. Information and knowledge gained in Dominica and St. Lucia will be transferred to other countries in the region through activities of the CRFM un-utilized resource working group. DBS fishery has been developed in subtropical Okinawa in Japan, which has fisheries conditions similar to those in the Caribbean region. DBS fishery has been one of the most important fisheries in Okinawa since its development in 1998. It is known that fishing operations are now diversified across available species populations (Figure 5-6).



**Figure 5-6: Landings by Fishery (Okinawa, Japan)**

The existence of DBS in the waters of the Caribbean has already been confirmed by a JICA/CFTDI Regional Technical Cooperation Promotion Program during 2000-2006. DBS is a highly productive species with a one-year life span, and a high quality meat. Proper utilization of un-utilized DBS resources in the region will contribute toward diversification of fishing operations across available species populations and benefit fishers' lives.

Below are the potential levels of FAD and DBS fishery development in the CARICOM countries:

- 1) Dominica, St. Lucia: Pelagic fisheries utilizing FAD has a long history and there is a high potential for DBS fishery, as well.
- 2) Grenada, Barbados, St. Vincent and the Grenadines, St. Kitts and Nevis: Pelagic

fisheries are common and have a long history, although FAD is partially used, and there is a high potential to develop FAD and DBS fishery.

- 3) Antigua and Barbuda: Reef fisheries are common while pelagic fisheries are not. However, some fishers use FAD, and there is a potential to develop FAD and DBS fishery.
- 4) Trinidad and Tobago: Pelagic fisheries and FAD in shallow waters are common and there is a potential to develop DBS fishery in Tobago.
- 5) Jamaica, Belize: Reef fisheries are common and pelagic while FAD fisheries are not. However, some areas have a potential to develop as FAD and DBS fisheries.
- 6) Haiti: Pelagic and FAD fisheries are not common, and infrastructure for pelagic fisheries is insufficient. Thus areas with potential to develop FAD and DBS fisheries are limited.
- 7) Guyana, Suriname: Neither FAD nor pelagic fisheries are common, and small-scale fishers have limited access to ocean pelagic, including DBS, because of a wide continental shelf and the long distance from the shore to offshore.

#### **5.3.5.3. Methods for Resource Management**

The following are useful methods in resource management, in which the draft FAD fishery management plan, as a result of the pilot project, is promising.

##### ***Fishery Co-management Plan***

A fishery co-management plan covers such aspects as policy, legislation, statistics, research and development, monitoring, evaluation, control, surveillance, enforcement, financing arrangements, advocacy and sensitization activities. All those activities are required to achieve a sustainable co-management system. Determining which activity is most critical for fishers/fishers organizations is vital. In the case of FAD fishery in Dominica and St. Lucia, a baseline survey unveiled critical issues which were discussed with fishers in the workshop. As a result, an activity to solve a direct problem, such as submersion and loss of FAD, became the first and most critical activity. This process of deliberation and working together to solve problems is a basis for good relationships. This bottom-up approach requires time and effort but proves effective in implementing a workable fishery co-management plan. (Details in Appendix 6: FAD Fishery Management Plan).

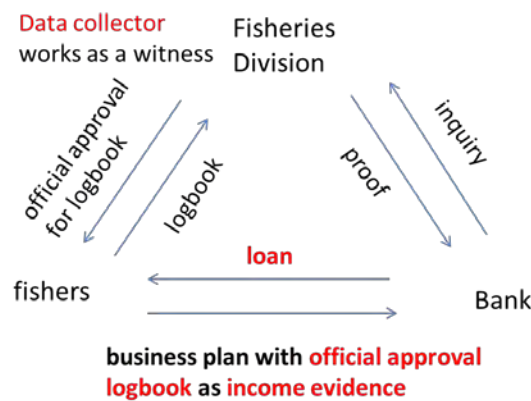
##### ***License System***

A license system for FAD fishing in Dominica is limited and fragile, and remains a challenge when shifting from open access to limited entry fishery, and clarifying the user's

responsibility for FAD fishing. It is important for fishers to clearly understand the benefits of this system, which ensures the fishing rights of each licensed fisher. Sensitization activities, such as a series of consultations with fishers, are indispensable. (See details in “Appendix 6 Annex 1: Revised draft regulations for fish aggregating device”, and “Annex 6 Rules on FAD management by NAFCOOP.”)

**Data Collection by Fishers and Record Keeping in a Logbook**

In Dominica, officially approved by the Fisheries Division, fishers’ logbooks are used for obtaining bank loans (Figure 5-7). This is a clear and visible benefit to fishers for providing data. Data collection by fishers themselves is an essential part of their small-scale business management, and the Dominica Fisheries Division has been promoting fishing logbooks as a business tool as well as resource management data collection tool through a Basic Fishermen Training Course (BFTC), which targets new entry fishers. Currently, only a small number of fishers with a high degree of awareness keep records of their fishing activities. It is necessary for fishers to collect the data on their own initiative.



**Figure 5-7: System for Using Fishers’ Logbook for Obtaining Bank Loans in Dominica**

This system was also adapted for FAD license fishers in order to collect their landing fees based on their records. It is a challenge to change fishers’ mentality for sustainable and responsible fisheries. However, this does not make the responsibilities of the fisheries divisions’ data collector any less important. Data from fishers’ logbook and data from data collectors complement each other under a co-management system. This system should be adapted for other aspects of fisheries resource management. In order to back up this system, the promotion of involvement of fishers’ family members, such as their partners or children, is important. Workshop and sensitization activities must be undertaken not only for fishers but also for their family members.

**Financial Sustainability**

In Dominica, both license and landing fee collection systems were established, while in St. Lucia, a FAD user’s fee is planned for the collection of fuel sales at each coop fuel station. The

establishment of a self-supporting fund generation system is vital for the sustainability of any organization. For successful fee collection, it is important that the benefits of paying the fee should be shown clearly to FAD users. Under a fee collection system, the FAD fishery management body should prepare sufficient spare materials and deploy, repair, and replace FADs on time to minimize fishers' economic loss. Therefore it is essential for the FAD fishery management body to establish a workable and practical fund generation and management system. Establishment of a self-supporting fund generation system is a key to the sustainability of any organization for other fisheries resource management, and must be considered by all the stakeholders from the initial stage.

### ***Rules and Regulations***

Rules and regulations should cover all aspects of fishery operations and management, based on a consensus of stakeholders under co-management. A series of consultations with fishers is indispensable to form a consensus of all the stakeholders. If an existing regulation is not covered by co-management, it should be modified and a voluntary regulation should be backed up by formal legislation. Since legislative procedures require time, the fisheries division/department should start this process from the initial stage.

The following are sample contents of a FAD fishery regulation.

- 1) Rules regarding the construction and placement of FAD
- 2) Clarification of the responsibilities of management organizations
- 3) Designated FAD
- 4) Clarification of identification and marking of FAD
- 5) Clarification of fishing operations near FAD
- 6) Clarification of FAD user license and fee
- 7) Clarification of FAD users' responsibility pertaining to provision of the required data (catch & effort, biological data)
- 8) Clarification of FAD users' responsibilities in resource management measures

### ***Sensitization Activity***

To obtain cooperation and commitment from FAD fishers for co-management of FAD fishery, it is important that the public recognize the contribution of FAD fishers to FAD fishery management. FAD fishers themselves should be given an opportunity to learn the importance of data collection for resource management and FAD fishery management. Then, the public needs to be informed of the FAD fishers' activities and contribution through such means as TV, radio, newspapers, posters, and pamphlets. In order to give FAD fishers the confidence and pride

necessary to collaborate in participatory management of the FAD fishery, public support must be secured. Therefore, a fishery management body should do all it can to obtain public support for the participatory management of the fishery.

#### **5.3.5.4. Small Pelagic Fish Resource Development and Management: Small Pelagic Fish Monitoring and Management Utilizing Modified Seine Net Fishing or Set Net Fishing**

Small pelagic fish, such as robin and jack, are mainly caught with seine nets, which are operated year round. Seine net fishing is a traditional fishing method in the island countries, and uses only skin divers and rowboats without any mechanical power. Approximately 10 to 15 fishers usually work together as a fishing team. During the peak fishing season, other people in the villages help with their fishing operation. Robin and jack are very popular fish for local consumption due to their lower prices than other pelagic fish. They are also used as bait for bottom long-line, trolling (line with bait), pot fishing, and pelagic longline fishing (live bait). Thus, seine net fishing is economically important for fishing communities.

The catch of small coastal pelagic fish seasonally fluctuates and is often influenced by natural environmental conditions. In some countries, the number of the fishing teams and total amount of fishing efforts by seine nets have gradually decreased due to degradation of coastal fishing grounds through land erosion, pollution, and tourism development. Collecting landing data of seine-net fishing is not easy, since seine-net fishers frequently change their landing sites according with the movement of fish schools. Collection of biological data of main target species as well as fishing effort data is also insufficient. Hence, identifying the resource trend of small coastal pelagic species is difficult at present.

Small pelagic fish working group member countries should conduct a baseline survey on the present situation of seine net fishing in each country, and discuss technology development for economic and efficient modifications of the traditional seine net design, construction, and operation including live bait technology, with practical monitoring, management, and marketing methods by fisheries administrators in collaboration with fisher organizations. These proposed ideas should be tested through a pilot program in the core countries. Results and lessons learned from the pilot program activities should be shared among the working group and utilized in creating draft management plans, including draft modified regulations, to ensure economic profits and sustainable resource monitoring methods. If this program is verified by the working group, it will be extended to other member countries as the next step.

In order to collect data of coastal small pelagic species, one option is to introduce small-scale set-nets as a monitoring tool of fish catch at the target sites. Set-net is stationary fishing gear, which mainly catches small coastal pelagic fish at fixed sites all year around and 24 hours a day. Moreover, it allows to let un-targeted fishes go alive, since they are kept alive in the net. Therefore set-net is very useful for collecting various fisheries data, such as landing and

fishing effort, as well as biological and oceanographic data. The participation of the local fishing community is a key to set-net operation and management. Small pelagic fish working group member countries should discuss the potential of set net fishing within the target communities in each country.

#### **5.3.5.5. Reef and Coastal Demersal (Slope) Fish Development and Management**

##### **(1) Prevention of ghost fishing by pot fishing**

Ghost fishing is defined as derelict fishing gear that has been either lost or abandoned and retains its capture function in water and continues inducing mortality of aquatic organisms without human control<sup>17</sup>. Generally, the capture function of derelict pots lasts much longer than that of other derelict fishing gear, because of their rigid structure and the technique used to attract fish. If lost, the entrapped fish in the pot would eventually die, becoming new bait and thus attracting and capturing more marine organisms, leading to a cycle of capture, decay, and attraction.

Fish pots are one of the main types of fishing gear to catch reef and demersal fish in the region. However, they are easily displaced and lost by strong tidal currents and rough seas during the hurricane season, and human causes such as misplacement, theft, and cutting off of flat line. A ghost fishing survey in Dominica unveiled that 1,450 pots were lost by Hurricane Dean in 2007 and over 1,800 fishing pots were lost after Hurricane Lenny in 1999<sup>18</sup>, although the situation in other countries in the region is unknown. Loss of fishing pots induces ghost fishing, a negative impact on these species resources, and economic damage to small-scale fishers. Here are the countermeasures against ghost fishing in order of priority.

- 1) Prevention of loss of fishing gear
- 2) Disablement of capture ability of lost fishing gear
- 3) Retrieval of derelict fishing gear

Prevention of gear loss is the most fundamental solution. Both technology development and community participatory monitoring and management of pot fishing are indispensable. In order to eliminate the capture ability of lost fishing gear, there is a practical application in fishery regulations of crab and shrimp pots in some countries, such as attachment of an escape ring or time-release device using a bio-degradable material. In some countries in the region, synthetic materials are already used for fish pot panels instead of traditional chicken wire panels, which increase the risk of ghost fishing. However, there is no particular regulation on pot fishing.

The reef and slope fish working group member countries should conduct a baseline survey

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<sup>17</sup> Matsuoka, T., Nakashima, T., Nagasawa, N., A review of ghost fishing: scientific approaches to evaluation and solutions, *Fisheries Science*; 2005, 71: 691-702

<sup>18</sup> Norman J. Norris, *Ghost Fishing Survey*, Dominica Fisheries Division, 2008



on the present situation of fishing pot loss in each country, and discuss technology development for the prevention of gear loss, as well as practical monitoring and management methods by fisheries administrators in collaboration with fisher organizations. The proposed ideas of technology development and monitoring and management methods should be examined in the pilot program in the core countries. Results and lessons learned from the pilot program activities must be shared among the working group and utilized for creating a draft management plan, including a draft modified regulation, to reduce ghost fishing and increase fisher's economic profits as well as sustainable resource use. If this program is verified by the working group, it will be extended to other member countries as the next step.

## (2) Stock enhancement with the maintenance of habitat and nursery ground

The maintenance of habitat and nursery ground is a highly effective tool to aggregate fishes living around coastal waters. It is also effective as nursery ground for juvenile fish. Moreover, maintained reefs can be used for rehabilitating areas degraded by natural disturbances and anthropogenic impacts. Therefore, the maintenance of habitat and nursery ground is undertaken in many marine protected areas and preserves as refuges. It is also expected to nourish a sense of stewardship to fishing ground in local fishers by having them participate in an activity to maintain the habitat and nursery ground for establish new fishing or nursery ground. It is indispensable to establish community-based advisory groups comprising stakeholders such as fishers, local researchers, and government officials to properly manage maintained reef areas. Such groups can provide management with relevant information for sustainable utilization of the maintained habitat and nursery and promotion of coastal fishery management through a participatory approach. Below are sample procedures for maintaining habitat and nursery ground.

- 1) Selecting the coastal area where surveillance by local fishers is easy
- 2) Explaining the contents of the project to the local community and persons concerned.
- 3) Finding candidate sites at which the ecological effects of the maintenance of habitat and nursery ground are easily borne out
- 4) Commencing a pilot project by preparing the maintenance of habitat and nursery ground
- 5) Monitoring the succession of the biota around the site by catch and diving research
- 6) Publicizing the monitoring results to local fishers and fishery officials, aiming at promoting an understanding of the effect of the maintenance of habitat and nursery ground and the importance of participatory approach on resource management
- 7) Structuring the management rules and surveillance system for utilization of maintained ground by relevant local small-scale fishers and fishery officials through official activities to raise public awareness

### **5.3.5.6. Marketing of Less Utilized and Unutilized Resources**

In order to develop un-utilized resources such as DBS, marketing is indispensable, and the marketing strategy must be carefully selected in consideration of characteristics of the real value of target species and the market environment in the region. In Dominica and St. Lucia, taking into account the high quality meat but limited catch of DBS in the initial stages, the marketing strategy was to target tourist restaurants and hotels in niche markets, and efforts made to conduct proper handling for a high-end market produced a certain result. Squid is not a common seafood in the region, but DBS is one of the most popular ones in the world for its high quality meat. The chefs in the target restaurants and hotels understood the value of DBS and accepted it as a high-priced commodity. This experience could be adapted for the marketing of other unutilized resources with high value.

On the other hand, utilization of non-popular fish, such as skip jack and marlin, by introduction of appropriate processing methods and cooking recipes, would be important to develop marketing.

### **5.3.5.7. Other Subjects**

#### **(1) Optimization of existing fisheries facilities**

Fish handling, primary processing, and marketing practice by small-scale fishers and fishers organizations are not sufficient to ensure that they can derive the maximum benefit from the exploited fisheries resource. To address this problem, many fishery facilities such as jetty, ice making machine, storage, and processing facilities have been introduced, mainly with grant assistance from the Government of Japan. However, many facilities have difficulties with management and maintenance due to technical, organizational, and financial constraints. Facility optimization with related training and strengthening of its management will promote not only community-based and sustainable fisheries management but also cost-effectiveness of the development assistance.

#### **(2) Effort to reduce operational costs**

For small-scale fishers, fishing operations with OBE are common and trigger high fuel consumption. Rising fuel prices have a serious negative impact on the economic condition of their fishing operations. Fishers' economic conditions greatly affect the effectiveness of measures for fisheries resource management. Reduction of fishing costs is an important issue for sustainable fishing operation. One solution is to promote four-stroke OBE for small-scale fishing boats. The four-stroke OBE features 45% lower fuel consumption and environment-friendly features compared to two-stroke OBE commonly used by small-scale fishers. High initial costs and the difficulty in obtaining proper service in local environment for four-stroke OBE are the main reasons why small-scale fishers are not interested in it. Sensitization activities to promote economic effectiveness of four-stroke OBE, in collaboration with the private sector, would be important. Four-stroke OBE with good service environment should be promoted in the region, to reduce operation cost and pollution, which indirectly links

with appropriate resource management. In addition, to further reduce costs, attention should be paid to vessel design and fishing operations.

## 5.4. Improvement of Fisheries Information

### 5.4.1. Background of the Plan

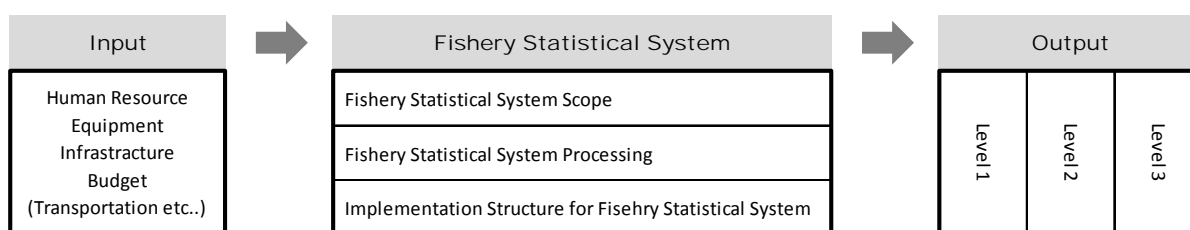
As previously discussed, fishery statistical data are vital when formulating fisheries policy, planning, management, and conducting research of fishery sectors in the Caribbean region, and implementing fisheries programs and activities for the sustainable use of fishery resources.

CFP focuses now on the following.

- (a) Collection and compilation of fisheries catch and fishing effort, registration and licensing data, and biological, ecological, economic, social, aquacultural, and any other relevant data;
- (b) Conduct research in order to ascertain the status of fish stocks, analyze the effectiveness of management and conservation measures, and so on.
- (c) Develop and maintain national and regional databases relating to (a) and (b) and develop and adopt appropriate standards for data and information sharing.
- (d) Analyze data and information collected and with awareness of any confidentiality requirements, disseminate it periodically to participating parties (such as the CARICOM member countries, FAO, and other relevant international organizations) and the CRFM Secretariat.

The inter-relationships among fishery statistical data, collection methods, analysis methods, and potential fishery resource management measures are summarized in the chapter 4 of this report. It is also crucial to verify whether the data can be obtained using existing resources allocated in the fisheries divisions/departments within each CARICOM member country. It is not realistic to expect all of the data mentioned to be collected with adequate quality by all the CARICOM member countries. Moreover, it is also essential to continuously compile the data until analysis is possible.

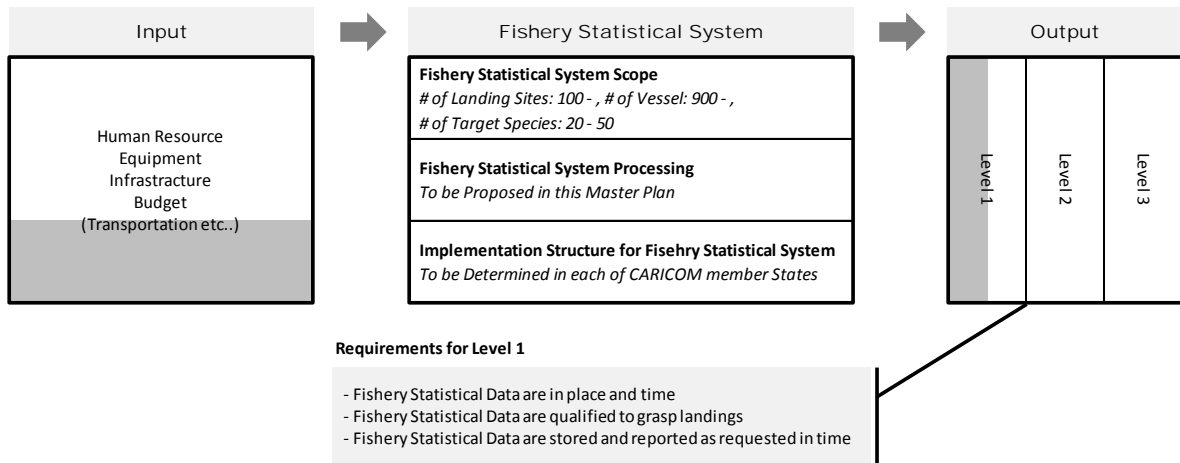
The fishery statistical data (Output) will be generated from the fishery statistical systems using the existing resources (Input) as shown in Figure 5-8.



**Figure 5-8: Diagram of Input, Output, and Fishery Statistical System**

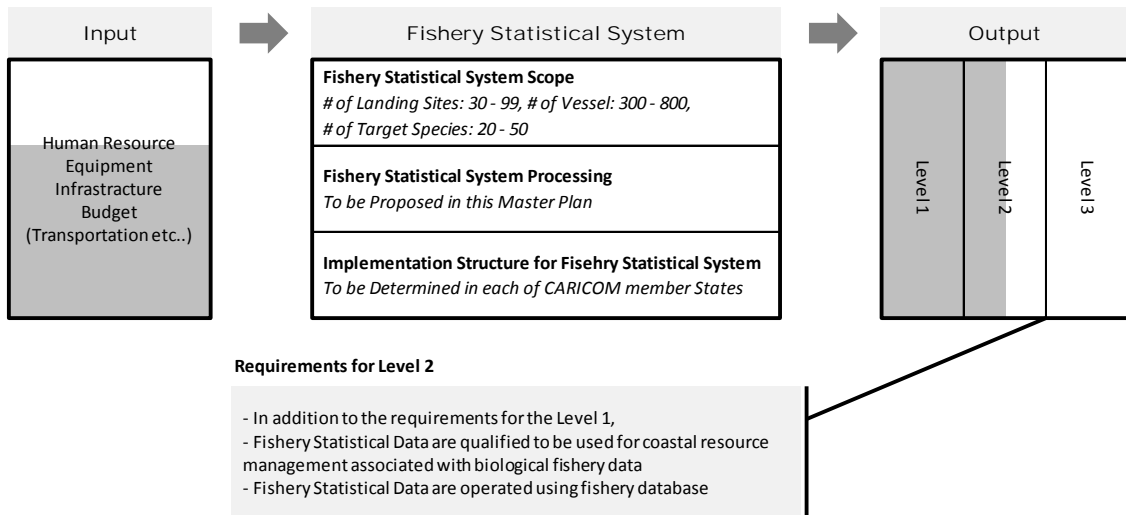
Since it is not realistic to expect increasing data input, an adequate approach is to improve the fishery statistical system in order to maximize the output using the existing input. Also, the scopes of possible input and fishery statistical systems differ for each CARICOM member country. The master plan of the fishery statistical system proposes improvements to the fishery statistical system using the existing resources allocated to meet requirements in fishery statistical data. The proposed fishery statistical systems model can be classified into three types corresponding to Groups A, B, and C accordingly, categorized in the baseline study.

Figure 5-9 shows requirements for the fishery statistical systems of “Level 1,” applied in the CARICOM member countries categorized as “Group C” such as Guyana, Suriname, and Haiti. These countries must target requirements for “Level 1” during the short term.



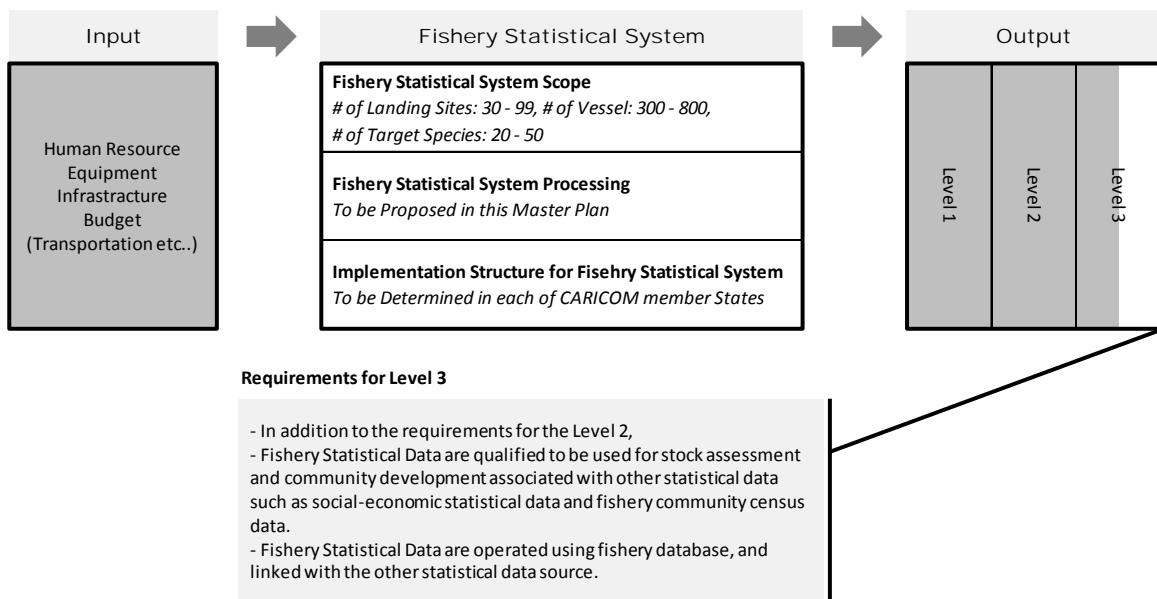
**Figure 5-9: Diagram of Input, Output, and Fishery Statistical System Group C (Level 1)**

Similarly, Figure 5-10 shows the requirements for the fishery statistical systems of “Level 2,” applied in the CARICOM member countries categorized as “Group B” such as St. Vincent and the Grenadines, St. Lucia, Grenada, Dominica, St. Kitts and Nevis, Antigua and Barbuda, and Belize. These countries must target requirements for “Level 2” during the short term.



**Figure 5-10: Diagram of Input, Output, and Fishery Statistical System Group B (Level 2)**

In the same way, Figure 5-11 shows the requirements of fishery statistical systems required for “Level 3,” applied in the CARICOM member countries categorized as “Group A” such as Trinidad and Tobago, and Barbados. These countries must target requirements for “Level 3” during the short term and mid-term.



**Figure 5-11: Diagram of Input, Output, and Fishery Statistical System Group A (Level 3)**

Jamaica was categorized as “Group A” in the baseline study; however, it should be categorized between “Group B” and “Group C.” To simplify the categorization, Jamaica will be placed as “Group B” on the condition that only commercially important species are targeted for resource management associated with the biological statistical data. It must target requirements for “Level 2.”

### 5.4.2. Scope of the Plan

Fishery Statistical Systems in the Caribbean region will be improved and enhanced in each CARICOM member country by the group they belong to in the short, medium, and long terms.

Table 5-3 shows the proposed log frame for each group in each term.

**Table 5-3: Summary of Purpose and Expected Outcome in the Master Plan for the Improvement of the Fishery Statistical System**

	<b>Short Term (1 - 3 years)</b>	<b>Medium Term (3 years – 5 years)</b>	<b>Long Term (5 years – 10 years)</b>
<b>Group C</b> Guyana, Suriname, Haiti	<b><u>Purpose</u></b> To satisfy the requirements for Level 1	<b><u>Purpose</u></b> To satisfy the requirements for Level 2 on condition that only commercially important species are targeted for resource management	<b><u>Purpose</u></b> To satisfy the requirements for Level 3 on condition that only commercially important species are targeted for resource management
	<b><u>Expected Outcome</u></b> - Fishery Statistical Data are in place and on time - Fishery Statistical Data are qualified to comprehend landings - Fishery Statistical Data are stored and reported as requested on time	<b><u>Expected Outcome</u></b> - The expected outcome for the short term has been satisfied - Fishery Statistical Data are qualified to be used for coastal resource management associated with biological fishery data - Fishery Statistical Data are used in a fishery database	<b><u>Expected Outcome</u></b> - The expected outcome for the medium term has been satisfied - Fishery Statistical Data are qualified to be used for stock assessment and community development associated with other statistical data such as social-economic statistical data and fishery community census data - Fishery Statistical Data are used in fishery database, and linked with other statistical data sources.
<b>Group B</b> St. Vincent and the Grenadines, St. Lucia, Grenada, Dominica, St. Kitts and Nevis, Belize, Jamaica	<b><u>Purpose</u></b> To satisfy the requirements for Level 2	<b><u>Purpose</u></b> To satisfy the requirements for Level 3	
	<b><u>Expected Outcome</u></b> - In addition to requirements for Level 1, - Fishery Statistical Data are qualified to be used in coastal resource management associated with biological fishery data - Fishery Statistical Data are used in fishery database	<b><u>Expected Outcome</u></b> - The expected outcome in the short term has been satisfied - Fishery Statistical Data are qualified to be used in stock assessment and community development associated with other statistical data such as social-economic statistical data and fishery community census data - Fishery Statistical Data are used in the fishery database, and linked with other statistical data sources.	
<b>Group A</b> Trinidad & Tobago, Barbados Antigua,	<b><u>Purpose</u></b> To satisfy the requirements for Level 3		<b><u>Purpose</u></b> To enhance the requirements for Level 3, and obtain more accurate statistical data with accumulated data over long periods To extend the system scope in the Caribbean region, and satisfy the requirements for levels 2 and 3
	<b><u>Expected Outcome</u></b> - In addition to the requirements for the Level 2, - Fishery Statistical Data are qualified to be used in stock assessment and community development associated with other statistical data such as social-economic statistical data and fishery community census data - Fishery Statistical Data are used in a fishery database, and linked with the other statistical data sources		<b><u>Expected Outcome</u></b> - The expected outcome for the medium term has been satisfied and continued for a long period - Extend the fishery resource assessment and management in the Caribbean region

In the short term, the CARICOM member countries in each group must satisfy the requirements for the level corresponding to their group.

During the medium term, the requirements for the next level for each group must be satisfied by the CARICOM member countries. The CARICOM member countries belonging to group A will continue to satisfy requirements for level 3.

In the long term, the member countries belonging to group C must satisfy requirements for one level higher (level 3). The member countries belonging to group B will continue to satisfy requirements for level 3. The member countries belonging to group A may extend their system scope covering additional fishery species, extending the fishery area for fishery resource management and assessment, and play a role in the regional fishery resource assessment as well as share results of the assessment with other CARICOM member countries.

### **5.4.3. Management Structure of Activities**

#### **5.4.3.1. Roles of CRFM Secretariat and Member Countries**

Management of the fishery statistical system will rest with CRFM as the responsible agency in the Caribbean region, while implementation of fishery statistical systems is conducted by the Fishery Division/Department in each of the CARICOM member countries. The roles of the CFP are to:

- (a) provide technical assistance and advice in connection with the implementation of agreement on the CFP, including, where appropriate, technical assistance and advice on national policy, management, or law or on sub-regional, regional, or global policy, management, or law;
- (b) make recommendations on any matters of the CFP;
- (c) coordinate or undertake data collection, research, and development activities;
- (d) provide coordination or cooperation facilities, services, or mechanisms, as may be required to fulfill the objectives of the agreement of the CFP.

Furthermore, in the CFP, it was addressed that the fishery authority in each of the CARICOM member countries, such as the respective fishery division or fishery department, will play a role in implementation of the management and operation of fisheries resources with their existing capacity and resources. In addition, the fishery authorities will take charge of the dissemination of

- (a) statistical data of fisheries;
- (b) information on research findings;
- (c) information on proposed management programs;
- (d) information resulting from implementation of management programs; and

- (e) information of activities undertaken for the implementation of the agreement on the CFP.

It is crucial for the Caribbean region to establish a regional fisheries mechanism for strengthening the fishery statistical systems in order to ensure long-term sustainable utilization and conservation of living aquatic resources, with efficient management and sustainable development of marine and other aquatic resources. This regional fisheries mechanism will build the institutional capabilities of CRFM and fisheries authorities in the CARICOM member countries to conduct research, collect and analyze data, improve networking and mutual collaboration, formulate and implement fishery policies, and make decisions on long-term sustainable utilization and conservation of aquatic resources in the Caribbean region. A summary of the mission and roles of the fishery statistical system for CRFM and fisheries authorities in the CARICOM member countries is shown in Table 5-12.

**Table 5-12.: Summary of Mission and Role for CRFM and the CARICOM Member Countries**

<b>CRFM</b>	<b>Fishery Authority CARICOM Member Countries</b>
<p><u>Mission</u></p> <p>To establish the Caribbean regional fisheries mechanism for strengthening the fishery statistical system, and propose a regional fishery policy for the sustainable use of resources in the region</p>	<p><u>Mission</u></p> <p>To provide the relevant fishery stakeholder with the fishery statistical data corresponding to its level identified for their group in the fishery statistical system, and propose the national fishery policy for the sustainable use of their fisheries resources</p>
<p><u>Roles</u></p> <ul style="list-style-type: none"> <li>■ To manage and operate the regional database for the Caribbean region</li> <li>■ To facilitate the CARICOM member countries in exchanging the fishery statistical data</li> <li>■ To provide the CARICOM member countries with necessary technical assistance such as fishery data collection methods, data management, data analysis, and reporting for their fishery statistical system</li> </ul>	<p><u>Roles</u></p> <ul style="list-style-type: none"> <li>■ To operate the fishery statistical systems, and improve them according to the proposed master plan</li> <li>■ To provide CRFM and participating parties in the fishery policy and management in the Caribbean region with the fishery statistical data corresponding to the level identified for their group on the fishery statistical system</li> <li>■ To participate in the relevant meetings and seminars in terms of fishery scientific analysis, fishery policy, and fishery management in the Caribbean region</li> </ul>

#### **5.4.3.2. Regional Cooperation and the Role of the Working Group**

A technical working group will play a major role in the Caribbean regional fisheries mechanism for the fishery statistical system through regional cooperation with the CARICOM member countries. The working group contributes to the following tasks in collaboration with



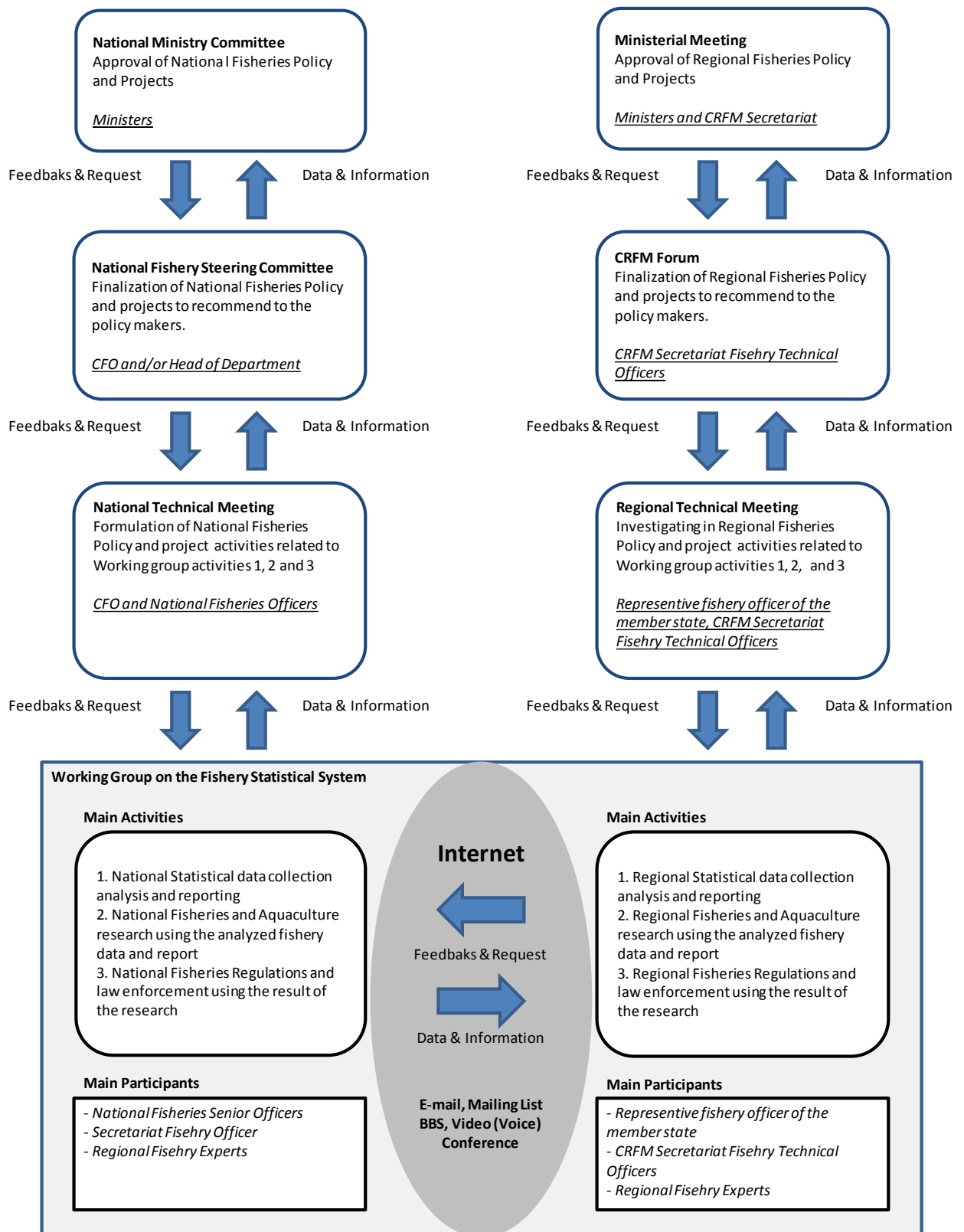
CRFM.

- (a) Coordinating activities on fisheries statistics and information management of the fishery statistical system in the Caribbean region
- (b) Fishery statistical data analysis
- (c) Monitoring and provision of technical assistance in national fishery statistical systems for the CARICOM member countries
- (d) Development and technical support in the application of the database for the fishery statistical system
- (e) Operation and management of the regional fishery database in the Caribbean region

Considering the above-mentioned tasks, it is necessary to identify the relevant stakeholders and fishery authority bodies as well as the implementation structure and information flow between the fishery authority bodies. Within the working group, fisheries senior officers in each CARICOM member country analyze the collected fishery statistical data, and develop a fishery statistical report in cooperation with CRFM Secretariat fishery technical officers and fishery experts if necessary; moreover, the fisheries senior officers must comprehend research on national fisheries and aquaculture, and discuss national fisheries regulations and law enforcement using the collected fishery statistical data, and share these fishery data with CRFM Secretariat fishery technical officers by means of E-mail, mailing list, and video conference via the Internet (Figure 5-12).

Regarding regional issues, CRFM Secretariat fishery technical officers will lead representative fishery officers of the CARICOM member countries in an investigation of the collected fishery statistical data from the CARICOM member countries, a study of regional fisheries and aquaculture, and discussions of regional fisheries regulation and law enforcement. This working group will convey regular meetings through such means as a mailing list, a Bulletin Board System (BBS), and video conferencing over the Internet.

All relevant fishery data and information from the working group regarding national and regional fishery statistical data, along with results of research, will be provided for the national technical meeting shown in the figure above, and be used for identifying and determining national fisheries policy and project management. They will also be provided to the higher level in the fishery authority body of CRFM and be used for identifying and determining regional fisheries policy and project management. Furthermore, from the higher level of the fishery authority bodies in the CARICOM member countries and CRFM, their fishery policy and needs of the fisheries and aquaculture development will flow back to the working group. An agenda and relevant collected fishery statistical data must be provided before any meeting, forum, or workshop by any level within the fishery authority bodies.

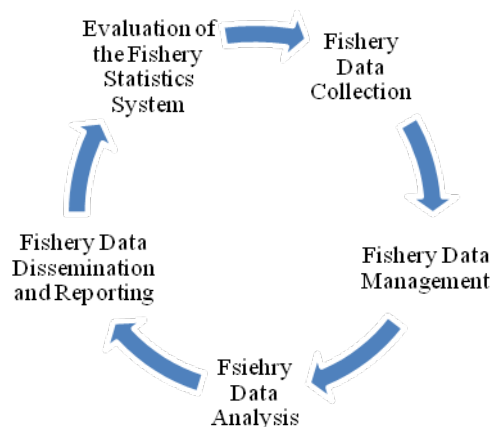


**Figure 5-12: Role of the Working Group and the Flow of Information from the Fishery Statistical System**

#### 5.4.4. Activities

##### 5.4.4.1. Methods for Improvement in the Fisheries Statistical System

Since it is crucial to improve the fishery statistical system in order to maximize the level of the fishery statistical data using the existing resources, strengthening the fishery statistical system and concepts of system process management will be introduced. A concept diagram for process management of the fishery statistical system is presented in Figure 5-13.



**Figure 5-13: Concept Diagram for the Fishery Statistical System**

Moreover, the following methods should be taken into account for a proposed fishery statistical system for the CARICOM member countries.

- ✓ All procedures and actions to be taken for the system should be identified, and the requirements and people in charge of them should be defined and documented
- ✓ The procedures and actions to be taken will be different for each of the categorized groups (A, B, and C).

The details of each fishery statistical system process are described below.

In the process of fishery data collection, the Catch per Unit Effort (CPUE) must be sampled for each vessel and gear type; sample size should be 0% - 10% of possible monthly sample size<sup>19</sup> in each vessel and gear type. During the process of fishery data management, the collected fishery data are to be compiled and stored using spreadsheet and/or database tools. The data management process requires compiled data to be on time. In the process of fishery data analysis, only basic fishery data analyses such as estimations of CPUE and landings and assessments of fishing activities are required. In the process of fishery data dissemination, fishery statistical data must be reported in a timely manner. In the fishery statistical system evaluation process, it is required to update relevant fishery data such as vessel counts, landing sites, sample target species, and terms used for fishery data collection and input, and so on.

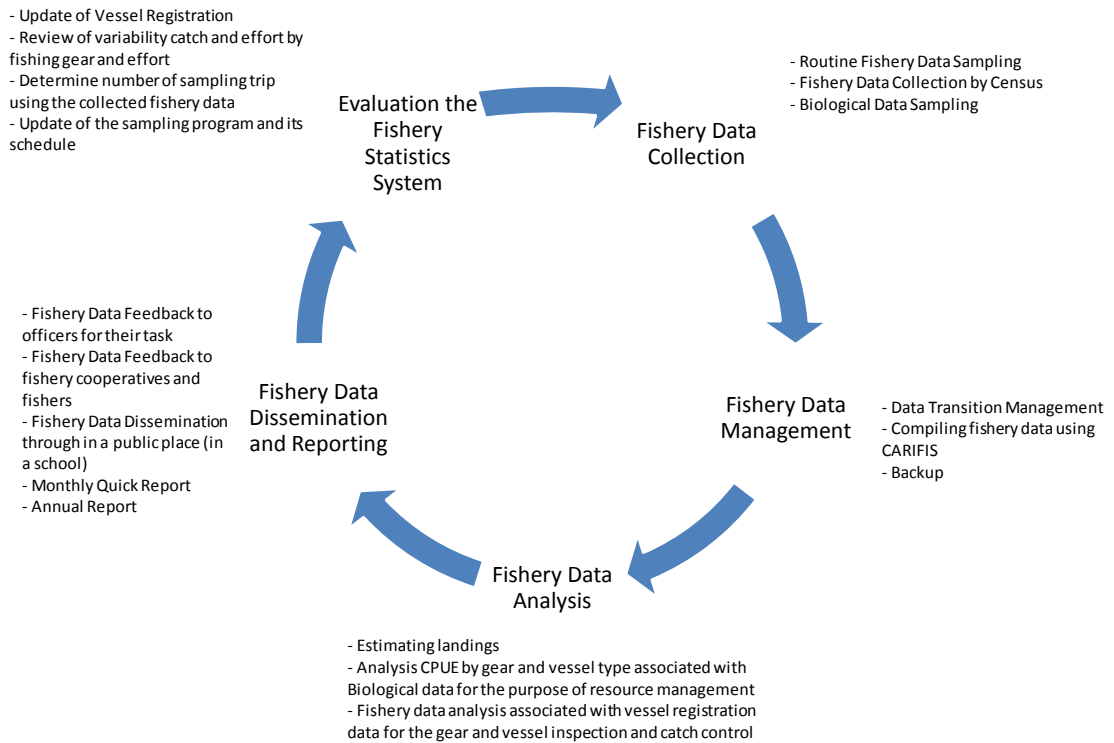
<sup>19</sup> Possible monthly sample size in each vessel and gear type will be estimated as follows: average times of fishing in a month and each vessel and gear type \* number of active vessel and gear type for the target landing area(s).

Moreover, the sample size, sampling schedule, and implementation structure for it needs to be updated for the next year's fishery data sampling (Figure 5-14).



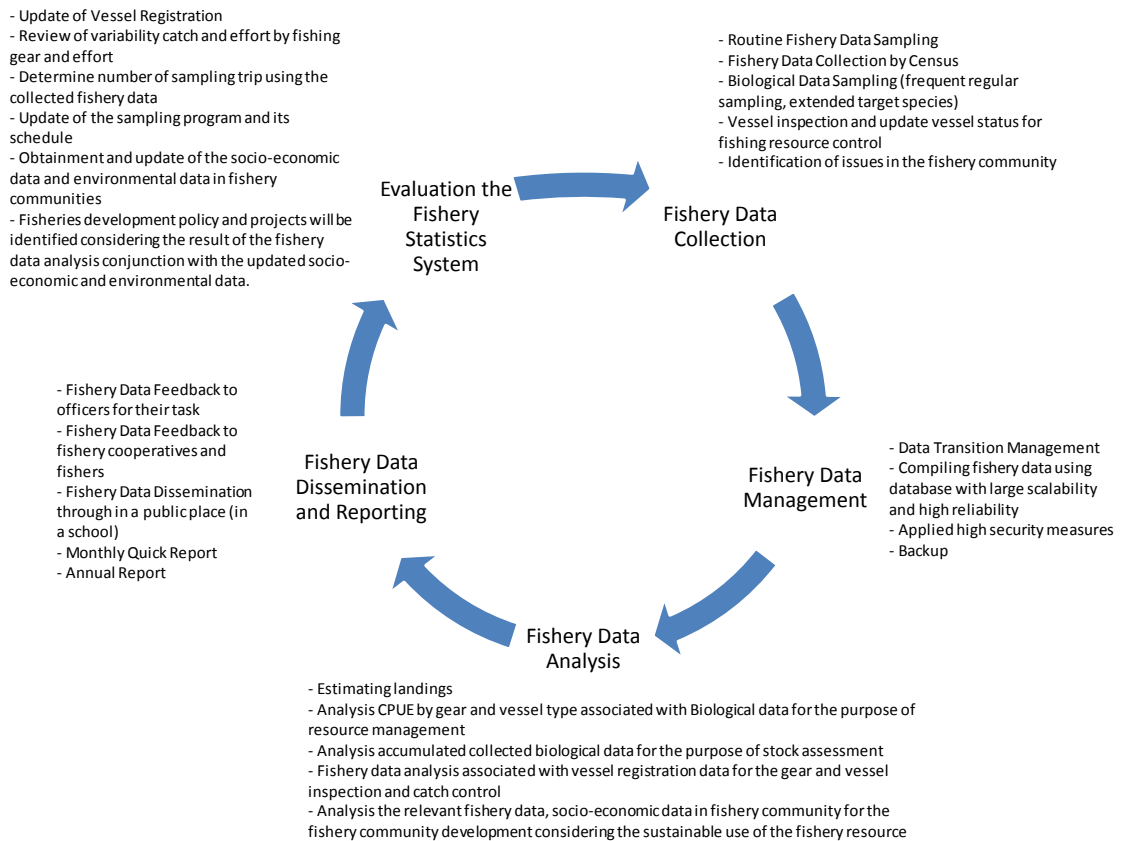
**Figure 5-14: Processes of the Fishery Statistical System for Group C (Level 1)**

In the process of fishery data collection, in addition to the requirements for level 1, it is necessary to conduct CPUE sampling for each vessel and gear type, associated with regular biological data sampling, with the monthly sample size 10% - 30% of possible monthly sample size in each of the vessel and gear types. In the process of fishery data management, the collected fishery data are compiled and stored using CARIFIS or any other equivalent qualified database tool. A requirement for the data management process is to provide accurate compiled data on time. In the process of fishery data analysis, collected biological data such as the identification of growth rates for main species and estimations of an ovulatory phase are to be completed for target species. In the process of fishery data dissemination, in addition to the requirements for level 1, it is also necessary to extend the dissemination of relevant fishery stakeholders, such as school and relevant fishery event, with the collected fishery statistical data. In the fishery statistical system evaluation process, it is necessary to update relevant fishery data such as vessel registration and inspection, stratification of landing site for fishery data sampling, sample target species, and terms used for fishery data collection and input. Moreover the sample size, sampling schedule, and implementation structure must be updated for the next year's fishery data sampling (Figure 5-15).



**Figure 5-15: Processes of the Fishery Statistical System for Group B (Level 2)**

In the process of fishery data collection, in addition to requirements for level 2, it is necessary to conduct vessel inspections and update vessel status for fishing resource control. Moreover, fishing communities must gain an understanding of issues and possible countermeasures. In the process of fishery data management, the collected fishery data are compiled and stored using a database with high scalability and reliability. A requirement in the data management process is to provide more accurate and variable compiled data on schedule and on time for the long-term. In the process of fishery data analysis, collected biological data such as the identification of growth rates for main species and estimations of an ovulatory phase for target species are completed, along with stock assessment in the coastal area; furthermore, socio-economic data and environmental data in the fishery communities are taken into account for fishery community development considering the sustainable use of fishery resources. In the process of fishery data dissemination, activities to meet requirements for level 2 will be continued for the long-term. In the fishery statistical system evaluation process, in addition to the requirements for level 2, it is necessary to identify a fisheries development policy and project management, considering the results of the fishery data analysis in conjunction with the updated socio-economic and environmental data in the fishery communities. Moreover, the target sampling data, sample size, sampling schedule, other relevant data for the fishery community development and implementation structure for the sampling and relevant data collection will be updated for the next year's fishery data collection (Figure 5-16).



**Figure 5-16: Processes of the Fishery Statistical System for Group A (Level 3)**

In conclusion, the fishery statistical system consists of several processes, and they are built in order. The fishery statistical system requirements are not expected to be satisfied in the identified current level of the system by the first and second year in the short-term period. As the system is built during this period, the fishery statistical system will gradually improve; it is expected to meet the requirements by the end of the short-term period, and aim for a higher level of the fishery statistical system in the medium- and/or long-term period.

#### **5.4.4.2. Implementation by Fishery Authority in Cooperation with Local Fishers and Traders**

In order to determine an implementation structure corresponding to the purpose and expected outputs, each of the CARICOM member countries would benefit by referring to the pilots for Guyana and St. Vincent and the Grenadine. Furthermore, it is critical to share the implementation structure with CRFM so that CRFM can identify the needs for technical support and verify the fishery statistical data provided by the CARICOM member countries through their fishery statistical system.

#### **5.4.4.3. Framework of Activities in the Short, Medium, and Long Terms**

The framework of the activities, purpose and expected outputs in the short, medium, and long terms for each group are described as follows. The full description, including the activities

corresponding with each output, is shown in the Appendix 7.

### ***Group C: Level 1***

**Purpose of Short Term:** To satisfy the requirements for Level 1

#### **Expected Outputs**

- 1: Fishery Statistical Data are on schedule and on time.
- 2: Fishery Statistical Data have been qualified to comprehend landings.
- 3: Fishery Statistical Data have been stored and reported as requested on time.

**Purpose of Medium Term:** To satisfy the requirements for Level 2 with the condition that only commercially important species are targeted for resource management

#### **Expected Outputs**

- 1: The expected outcome for the short term has been satisfied.
- 2: Fishery Statistical Data have been qualified to be used for coastal resource management associated with biological fishery data.
- 3: Fishery Statistical Data are operating using fishery database

**Purpose of Long Term:** To satisfy the requirements for Level 3 on condition that only commercially important species are targeted for resource management

#### **Expected Outputs**

- 1: The expected outcome for medium term has been satisfied.
- 2: Fishery Statistical Data are qualified to be used for stock assessment and community development associated with other statistical data such as social-economic statistical data and fishery community census data.
- 3: Fishery Statistical Data are incorporated into the fishery database, and linked with other statistical data sources.

### **Group B: Level 2**

**Purpose of Short Term:** To satisfy the requirements for Level 2

#### **Expected Outputs**

- 1: The requirements for Level 1 is satisfied

**2:** Fishery Statistical Data are qualified to be used for coastal resource management associated with biological fishery data.

**3:** Fishery Statistical Data are used when operating the fishery database.

**Purpose of Medium Term/Long Term:** To satisfy the requirements for Level 3

**Expected Outputs**

**1:** The expected outcome for the short term is satisfied.

**2:** Fishery Statistical Data are qualified to be used in stock assessment and community development associated with other statistical data such as social-economic statistical data and fishery community census data

**3:** Fishery Statistical Data are operated using fishery database, and linked with the other statistical data sources.

**Group A: Level 3**

**Purpose of Short Term/Medium Term:** To satisfy the requirements for Level 3

**Expected Outputs**

**1:** The requirements for Level 2 is satisfied.

**2:** Fishery Statistical Data are qualified to be used for stock assessment and community development associated with other statistical data such as social-economic statistical data and fishery community census data.

**3:** Fishery Statistical Data are used when operating the fishery database, and linked with other statistical data sources.

**Purpose of Long Term:** To enhance the requirements for Level 3, and obtain more accurate statistical data with accumulated data over a long period; To extend the system scope in the Caribbean region, satisfying the requirements for levels 2, 3

**Expected Outputs**

**1:** The expected outcome for the medium term has been satisfied and continued during the long-term period.

**2:** Extend the fishery resource assessment and management in the Caribbean region.



#### 5.4.4.4. Regional Database

CARIFIS was designed as the fisheries database for the countries in the Caribbean region. However, it has been introduced in only a few CARICOM member countries. The reasons why it has not been introduced as planned are as follows.

- Technical support for CARIFIS operations was inadequate. A database manager should have been assigned for technical support within CRFM.
- It was too ambitious to obtain a standardized database for all the CARICOM member countries when the fishery statistical systems of the respective CARICOM member countries differ in policy, management, and capability.
- Although the member countries faced difficulties in introducing CARIFIS, using a database to operate and maintain the fishery statistical data was strongly proposed to avoid operation errors such as mistyping dates, names of species, landing sites, and incompatible data formats. In other words, using a database contributes to more accurate fishery data, and facilitates effective and efficient production, by the fishery officers, of the necessary reports with collected fishery statistical data.

Considering the above-mentioned concerns, it is recommended that the CARIFIS application be regarded as an available database tool to operate the fishery statistical data in the Caribbean region, but not be designated as the standardized regional database. It is possible for the member countries to use their own tool corresponding to its policy, level of computer literacy, and capability of fishery statistical data management. CRFM may provide the CARICOM member countries with technical support on CARIFIS application for fishery database management to those member countries interested in using the CARIFIS application and database, especially for member countries belonging to group B in the short term of the master plan. The most important task for CRFM with regard to fisheries statistics and information is to design a regional mechanism and protocol for sharing fishery data in the Caribbean region. Another task is the formulation of a plan to implement the protocol for sharing the regional fishery data as well as maintaining the mechanism and its protocol. The protocol consists of two parts: a matrix for fishery data sharing and a procedure for sharing the fishery data between CRFM and the CARICOM member countries. The former is a matrix table to classify the fishery data to be shared for each group on the fishery statistical system in the master plan, and the latter is a process flow presenting the procedures to share the fishery data in collaboration with CRFM and the CARICOM member countries. The proposed protocol is presented in Table 5-13 and Figure 5-17.

**Table 5-13: Classification Matrix for Fishery Data to Be Shared on the Regional Database**

Data Item	Term	Short Term			Medium Term			Long Term		
	Group	A	B	C	A	B	C	A	B	C
<b>Fishing Vessel and License Information</b>										
Vessel count				O						
Vessel registration		O	O		O	O	O	O	O	O
Vessel inspection status		O	Δ		O	O	O	O	O	O
Issues on vessel registration		O	O		O	O	O	O	O	O
Fishing License data		O	Δ		O	O	O	O	O	O
Issues on fishing license registration.		O	Δ		O	O	O	O	O	O
<b>Fish Catch and Landing Data</b>										
Estimated landing data		O	O	Δ	O	O	O	O	O	O
CPUE per gear and vessel type (0-9%)*1				O						
CPUE per gear and vessel type (10-30%)*1			O				O			O
CPUE per gear and vessel type (50% -)*1		O			O	O		O	O	
<b>Biological Fishery Data</b>										
Detailed biological data for target species*2		O	O	O	O	O	O	O	O	O
Simplified biological data for target species*3		O	O	O	O	O	O	O	O	O
Analyzed data for fishery resource management*4		O	O		O	O	O	O	O	O
Analyzed data for stock assessment and fishery development*5		O			O	O		O	O	O
<b>Fishery Statistic Report</b>										
Updated stratification of landing sites		O	O	O	O	O	O	O	O	O
Fishery statistical data sampling program*6		O	O	O	O	O	O	O	O	O
Fishery statistic annual report		O	O	O	O	O	O	O	O	O
Regional fishery data report					O	Δ		O	O	Δ

\*1 Rate of sample size is “number of samples”/“number of maximum possible samples” per gear and vessel type.

\*2 The detailed biological collected data include fish weight, length, gonad weight, maturity, and so on. This data will be collected for the target species for at least a year, in order to optimize and simplify the biological fishery data collection.

\*3 The simplified biological collected data include, for each target species, only landed total weight, number of fish, maximum fish size, and minimum fish size.

\*4 Data analysis for the fishery resource management results in determination of restricted period for the target species, restricted fishing gear mesh size, and so on.

\*5 Data analysis for the stock assessment and fishery development results in determination of trends and projection of the available fishery resources, development plan for fishery and aquaculture in fishery communities, and so on.

\*6 The sampling program includes data sampling method, data sampling coverage, case of sampling schedule, implementation structure for the sampling, fishery data management method, estimation method for landings (CPUE, raising factor and estimation formula) and effect on the fishery statistical data, fisheries resource management, and fishery and aquaculture development.



**Figure 5-17: Procedures for Regional Mechanism to Share the Fishery Statistical Data in the Caribbean Region**

In the future, the regional database will be used to maintain the balance between fishing capacity and fisheries resources through the establishment and maintenance of national and regional fishing vessel registration and fisheries resource management in cooperation with CRFM; moreover, the CARICOM member countries need to consider the development of harmonized procedures to develop fishery and aquaculture statistics for the sustainable use of the fisheries resources in collaboration with CRFM.

## **5.5. Development of Alternative Income Sources**

### **5.5.1. Background of the Plan**

To achieve sustainable coastal community development, sustainable use of fisheries resources is critical. However, other income generating activities are also needed to keep up with the increasing number of community members. Development of alternative income sources is also important to address the effects of climate change and to build resilient communities capable of withstanding environmental changes. Sustainable development is presently the major issue for the fisheries sector, which is described in CFP as *“Promote the sustainable development of fishing and aquaculture industries in the Caribbean region as a means of, inter alia, increasing trade and export earnings, protecting food and nutrition security, assuring supply to Caribbean markets and improving income and employment opportunities.”* Small-scale aquaculture, as opposed to large-scale one, is presently a topic in aquaculture development, because of the necessity for the improvement of income and employment opportunities in rural communities. Coastal communities in the Caribbean are particularly dependent on coastal fishing activities to earn cash incomes in order to sustain their livelihoods. Since fishery resources in coastal waters tend to decrease under the pressure of large and uncontrolled fishing efforts, local fishers’ incomes from fishing activities have diminished. Coastal communities need to consider small-scale aquaculture as an alternative income source to their coastal fishing activities.

Tilapia has high potential as a fish species for small-scale aquaculture development in the region, because it can be cultured relatively easily in fresh-water ponds as well as brackish-water ones. Results from the pilot project indicate that small-scale tilapia aquaculture would have a high probability of success as an alternative income source for small-scale coastal fishers. Additionally, tilapia is commonly marketed as fresh fish and is available in local markets of respective countries. Tilapia also has a potential to compensate for shortages of local coastal fish such as snappers and groupers, because of the characteristics of tilapia fish meat (color, taste, and texture) are similar with those of local coastal fishes. However, small-scale tilapia aquaculture by the people in coastal communities is not developed in the region, due to limitations in both technical and financial capacities.

The fisheries authorities in the region need to take the lead in this development. Unfortunately, most fisheries agencies in the region have limited capability in their aquaculture sections. Therefore, some of the countries can initially work in developing and implementing aquaculture development plans while sharing the information generated with the other member countries.

A regional networking structure for aquaculture development would be essential to facilitate the regional-wide aquaculture development. This regional network program would

enable CRFM member countries to share their experiences and ideas for aquaculture development as well as encourage the articulation of a vision for regional aquaculture development.

### **5.5.2. Scope of the Plan**

The scope of the plan necessitates the regional development of small-scale aquaculture as an alternative income source to compensate for the diminishing income from fishing activities in the coastal area as well as a sub-sector capable of contributing to food security at the local, national and regional levels. It should be formulated based on the capability of the fisheries authorities in the region and should be composed of a two-step process which will be carried out initially by some of the core countries, followed by other countries adapting the results. In addition, the duration of the plan will be ten years divided into three phases: short term (two to three years), medium term (five years), and long term (ten years).

#### **5.5.2.1. Purpose of the Plan**

##### ***Short Term***

- Finalize the aquaculture development plans for the core group of countries; mobilize resources and begin implementing the respective plans.
- Finalize the project for the development of the regional network of aquaculture organizations; mobilize resources and start establishing the network.
- Establish links with the aquaculture network for the Americas and NACA.

##### ***Medium Term***

- Review the implementation of the aquaculture development plans in the core countries; make any adjustments required and share the information with other member countries through the network.
- Review the network performance and make any required adjustments.
- By way of the network, provide assistance to other member countries in the preparation of aquaculture development plans; mobilize resources and begin implementation.

##### ***Long Term***

- Small-scale aquaculture development in the region accomplished; contribution to the improvement of the quality of life at the local level; and contribution to food security and poverty alleviation

#### **5.5.2.2. Expected Outcome of the Plan**

##### ***Short Term***

- Small-scale aquaculture development initiated in the core countries

- The regional network of aquaculture organizations established
- Links established with the network for the Americas and NACA

#### ***Medium Term***

- Small-scale aquaculture development continuing in the core countries, with the information being shared by way of the network
- Other member countries developing aquaculture development plans with technical assistance from the network; resources mobilized and plans implemented

#### ***Long Term***

- Small-scale aquaculture development in the region accomplished; contribution to the improvement of the quality of life at the local level; and contribution to food security and poverty alleviation

### **5.5.2.3. Expected Impact of the Plan**

#### ***Short Term***

- The production from small-scale aquaculture development being distributed through the appropriate marketing channels

#### ***Medium Term***

- Feed supplies for small-scale aquaculture development being produced locally, using mainly local raw materials

#### ***Long Term***

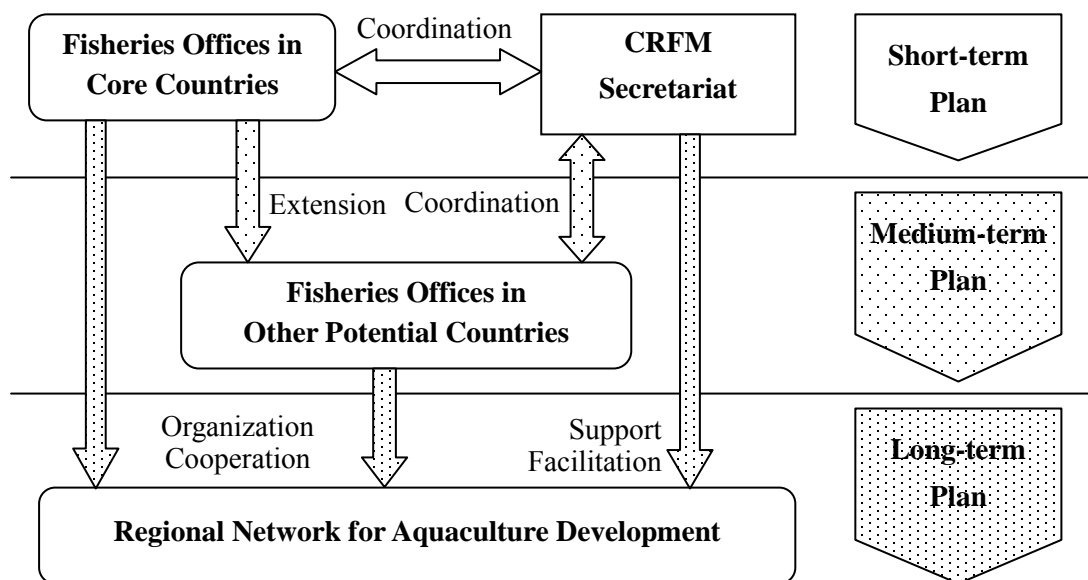
- The migration of people to urban areas from rural areas due to lack of employment opportunities is eased.

### **5.5.2.4. Regional Cooperation and the Role of Working Group**

In the small-scale aquaculture development program, the respective target countries will take responsibility for their own program planning and operation. However, the experiences of advanced countries in the extension program will be utilized for the next wave of programs in other countries. It will be important to transfer improved technical skills and practical experience from advanced countries to other potential sites in aquaculture development.

Initially, during the short term, programs for small-scale aquaculture development will be carried out in core countries with coordinated efforts between their fisheries offices and the CRFM Secretariat. Then, in the medium term, based on the experiences and lessons learned from the short term activities, other potential countries will receive the technical support and advice for small-scale aquaculture development through the network from the core countries. The CRFM Secretariat will coordinate an overall program of regional aquaculture development with the fisheries offices of the member countries.

During this program period, CRFM Secretariat will also facilitate the establishment of a regional network structure for aquaculture development. This regional network structure, instead of the main body of CRFM, will provide smooth coordination for information sharing, technology transfer, regional training, and extension programs for aquaculture development. The image of the coordination structure of regional aquaculture development program is shown in Figure 5-18.



**Figure 5-18: Image of Coordination Structure of Regional Aquaculture Development Program**

To develop seed production and grow-out skills of culture species, existing aquaculture facilities belonging to the member countries, such as freshwater fish farms or hatcheries, should be utilized for regional aquaculture programs. At present, the freshwater culture centers and hatcheries in Jamaica, Belize, Guyana, or St. Lucia have minimal capacities and equipment to develop breeding and culture skills of target culture species.

### 5.5.3. Activities of the Plan

On the basis of the following criteria, the core countries shall be determined in a discussion

in CRFM's aquaculture working group (Table 5-14).

**Table 5-14: Definition of Core Countries and Potential Countries of Aquaculture Development**

Definition of Countries	Standard Criteria	Possible Candidate Countries
Core Countries	<ul style="list-style-type: none"> <li>● Environment is favorable to start fresh water aquaculture.</li> <li>● Hatchery and or aquaculture facility exists.</li> <li>● There are staff members specialized in aquaculture development and extension.</li> </ul>	<ul style="list-style-type: none"> <li>- Jamaica</li> <li>- Belize</li> <li>- Guyana</li> <li>- St. Lucia</li> <li>- Suriname</li> <li>- Trinidad &amp; Tobago</li> <li>- Haiti</li> </ul>
Potential Countries	Satisfy two of the above criteria.	- Other appropriate countries

#### **5.5.3.1. Activities of Short-term Program**

The activities of the short-term program are as follows.

Activity 1: Finalize the aquaculture development plans for the core countries.

- 1-1 Mobilize resources for the implementation of the aquaculture development plans in the core countries.
- 1-2 Begin implementation of the aquaculture development plans in the core countries.
- 1-3 Finalize the project for the establishment of a regional network of aquaculture organizations and mobilize resources.
- 1-4 Start implementing the project to establish the regional network of aquaculture organizations.

#### **5.5.3.2. Activities of Medium-term Program**

The activities of the medium-term program are as follows.

Activity 2: Expand the aquaculture development program to other member countries.

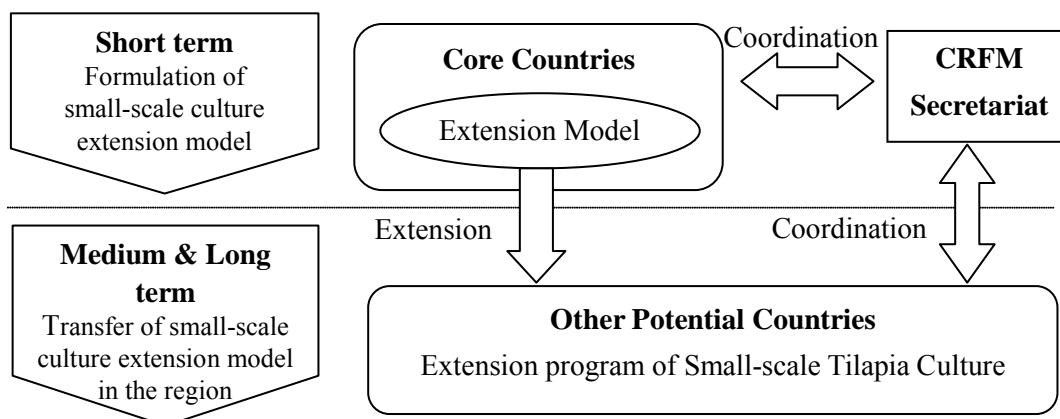
- 2-1. Assist other member countries to develop aquaculture development plans and mobilize resources.
- 2-2. Start implementing the aquaculture development plans in the other member



countries.

2-3 Continue to establish the regional aquaculture network.

The image of extension process of small-scale tilapia culture in the region is shown in Figure 5-19.



**Figure 5-19: Image of Extension Process of Small-scale Tilapia Culture in the Region**

Activity 4: Develop the aquaculture techniques of other species which are suitable for small-scale aquaculture in the coastal communities in the core countries.

- 4-1. Select some target species according to the demands of local and regional markets and the experiences of past aquaculture programs.
- 4-2. Rehabilitate/improve the existing aquaculture facilities as centers of excellence for regional aquaculture development for the other species. The existing facilities for aquaculture research in the Caribbean are shown in Table 5-15.
- 4-3. Develop the aquaculture techniques of selected species utilizing the aquaculture facilities rehabilitated in Activity 4-2 (Centers of Excellence for Aquaculture) in the core countries.

**Table 5-15: Existing Facilities for Aquaculture Research in the Caribbean Serving as Candidates of Centers of Excellence for Aquaculture**

Country	Section in Charge	Aquaculture Research Facilities	Main Culture Species
Jamaica	Aquaculture Branch, Fisheries Division	Freshwater Aquaculture Center	- Tilapia - Ornamental Fishes
		Oyster Culture Station	- Mangrove Oyster
Belize	Aquaculture and Inland Fisheries Unit, Fisheries Department	Freshwater Fish Hatchery	- Tilapia
Guyana	Aquaculture and Inland Fisheries Unit,	Freshwater Fish Hatchery	- Tilapia

	Fisheries Department		
St. Lucia	Aquaculture Unit, Department of Fisheries	Freshwater Aquaculture Center	- Tilapia - Freshwater prawn

### 5.5.3.3. Activities of Long-term Program

Activity 5: Continued promotion of small-scale aquaculture development at the national and regional levels

5-1. Continue to implement the aquaculture development plans in all the member countries involved.

5-2 Continue to build the regional network of aquaculture organizations and strengthen the linkages with the network for the Americas and NACA.

## **6. Conclusion and Recommendations**

### **6.1. Conclusion**

#### **6.1.1. Scope of the Study**

In the Scope of Work, the Study was defined to focus on sustainable resource management of small-scale fisheries and their resource management in the CARICOM member countries. The Study investigated the following five components; (1) Pelagic resource development and management; (2) Aquaculture development and policy formulation; (3) Regional fisheries database development, (4) Support for community-based management (including sedentary resource management), and (5) Education and training of staff members of fisheries authorities and CRFM Secretariat<sup>20</sup>.

As the Study covered 13 countries and wide aspects of fisheries, it was a difficult and time consuming task. Without strong leadership of the CRFM Secretariat and the knowledge of its staff, the Study would not have been as successful.

#### **6.1.2. Lessons Learned from the Pilot Projects**

It was found to be very productive to implement similar pilot projects concurrently in two countries. Sharing experiences and information has stimulated the activities in both countries and increased efficiency of the projects.

In order to encourage participation of fishers, it was confirmed that provision of technical guidance and/or financial incentives is essential. Support for FAD design improvement and the provision of technical training, for example, proved to be a good incentive.

Pilot projects provided an opportunity for fisheries authorities and fishers to work together toward co-management of fisheries resources. Action oriented fishers groups, such as FAD management and DBS marketing groups, were established during the period of pilot projects.

Participation of fishers in fishery data collection was found to be a key to fisheries statistical system development. Communication between fishers and fisheries authorities needs to be strengthened through regular meetings and feedback of the information given by fishers. Providing the tax exemption of fuel or fishing gear to the fishers who submit fishery data, will further encourage the participation of fishers.

Usage of the CARIFIS application was investigated in detail. Data transfer from old databases to CARIFIS was conducted in two countries successfully. The use of an older version of the Windows operating system, which is not compatible with CARIFIS, was a major constraint.

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<sup>20</sup> Although recommendations were limited to small scale fishers and fish farmers, industrial fisheries and large-scale aquaculture should also be respected. They are very important for a country's fisheries development and management and directly influence small-scale fisheries.

Low-cost input aquaculture using fermented rice bran has potential. It has a longer farming period but is suitable for families with a lower opportunity cost. Small-scale aquaculture showed potential as an alternative income source for small-scale fishers.

Training and extension methods on small-scale aquaculture was improved. It was found that intermediate culture would be a good option to increase the number of aquaculture farms. The introduction of intermediate culture will reduce the grow-out culture stage period. A shortened culture period with limited initial investment will allow more small-scale farmers to practice fish farming.

Aquaculture development plans were formulated for the participating countries during the first and second regional aquaculture workshops conducted under a pilot project. The idea of aquaculture networks was discussed during the regional aquaculture workshops and an outline of the activities for them was formulated.

Various manuals and technical reports were produced during the implementation of the pilot projects. Staff members of fisheries authorities as well as the CRFM Secretariat enhanced their knowledge and skills by working closely with the study team.

### **6.1.3. Two Guiding Principles and Four Approaches**

During the Study, the strategy for resource management for small-scale fisheries as well as for increasing regional cooperation efficiency and effectiveness was evaluated. Fisheries resource management not only encompasses fishing regulations but also the economic benefit to fishers and their communities. It emphasizes the importance of a comprehensive approach that includes diversification and economic efficiency in fishing, the development of alternative incomes, and the collection of fisheries information that are vital for fundamental resource management and development. Since all the CARICOM member countries suffer chronic shortage of human and financial resources, fisheries resource management and development remains a challenge. It is therefore advantageous to promote co-management with participation from fishers, coastal communities, and governmental organizations. In order to utilize limited human and financial resources effectively, it is also necessary to strengthen and develop regional networking. Thus, the promotion of co-management and the strengthening of regional network compose the guiding principles for resource management and development of small-scale fisheries in this Study.

### **6.1.4. Technical Service Programs for Regional Cooperation**

Regarding an implementation structure, the establishment of five service programs within CRFM was proposed to address technical issues within member countries (e.g., Figure 5-3 in Chapter 5). Each service program is composed of a working group with members from various countries and regional specialty institutes so that they can exchange information and enhance the fisheries resource management ability of the member countries as well as the region. Those countries that lead in a particular subject area will be referred to as core countries and CRFM

will provide technical support with the agreement of the countries. The core countries will then transfer the technologies and knowledge to other member countries for promoting region-wide development.

## **6.2. Recommendations**

### **6.2.1. Need to Collaborate with Industrial Fisheries**

The result of the pilot project in Guyana explained in 3.5.4.1. indicate that the influence of industrial fisheries in resource management cannot be ignored. For example, data of the amount of by-catch by shrimp trawlers should be obtained to manage the target fish of small-scale fisheries. It is necessary to conduct by-catch surveys with collaboration of industrial fisheries. It is recommended to implement such surveys in the future.

### **6.2.2. Alternative Income Sources**

Aquaculture is a potential alternative income source for small-scale fishers. For the coastal community and small-scale fishers, tourism and agriculture also have potential for alternative income sources. Since the Study concentrated on the fisheries sector, tourism and other sectors were not included in the master plan. It is recommended to investigate tourism and other sectors' activities as alternative income sources for small-scale fishers.

### **6.2.3. Potential for Aquaculture Development**

Aquaculture also has an important role in food security. Since large-scale industrial aquaculture in developing nations usually involves foreign investment and tends to gain profit in a short period of time, the target species for production are often the ones to satisfy the export market and not aimed for the local market. Considering the food security as well as ecological nature of fish products, it was thus considered that the target of aquaculture development is to increase of fish supply to a country's own market through promotion of small-scale aquaculture at this time. However, some countries have favorable environment as well as economic and geographical advantages to pursue export market for aquaculture products. Careful marketing survey and technical investigation are required before implementation of aquaculture development so that ecologically, socially and financially sustainable aquaculture is realized.

### **6.2.4. Strengthening of CRFM**

Regional cooperation has been put in place mostly in a top-down style and resulted in limited action and outputs. A proposed regional network based on the five service programs and their working groups of CRFM is an approach that utilizes the bottom-up strategy.

With the strengthened regional network, CRFM will be a more effective and responsive organization for the member countries' genuine needs and initiatives. Member countries are able to improve their ability to tackle their issues with priorities through accurate information provided by the use of the regional network. There is a clear merit for donor communities to

support CRFM and its regional network as it will assure the efficiency and effectiveness of the activities.

It should be noted that both the network and co-management will be enhanced not only through communication but through actions. It takes continuous effort to keep fishery resources at an optimal level. It is recommended to accumulate successful cases through actions and producing tangible outputs that will be a driving force to improve resource conditions and achieve sustainable use of those resources.