Report of the

CARICOM/CRFM/JICA First Regional Workshop on Aquaculture Development Planning

Kingston, Jamaica
14 – 21 March 2011

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## CONTENTS

1.0 Background .................................................................................................................. 1
2.0 Workshop Arrangements .............................................................................................. 2
3.0 Country Reports ........................................................................................................... 2
   3.1 Belize ......................................................................................................................... 2
      3.1.1 Report summary .................................................................................................. 2
      3.1.2 Discussion ......................................................................................................... 2
   3.2 Guyana ........................................................................................................................ 3
      3.2.1 Report summary .................................................................................................. 3
      3.2.2 Discussion ......................................................................................................... 3
   3.3 Haiti ............................................................................................................................. 4
      3.3.1 Report summary .................................................................................................. 4
      3.3.2 Discussion ......................................................................................................... 4
   3.4 Jamaica ........................................................................................................................ 5
      3.4.1 Report summary .................................................................................................. 5
      3.4.2 Discussion ......................................................................................................... 5
   3.5 Suriname ....................................................................................................................... 6
      3.5.1 Report summary .................................................................................................. 6
      3.5.2 Discussion ......................................................................................................... 6
   3.6 Trinidad and Tobago .................................................................................................... 7
      3.6.1 Report summary .................................................................................................. 7
      3.6.2 Discussion ......................................................................................................... 7

4.0 Field Trips ..................................................................................................................... 8

5.0 Aquaculture Development Planning .............................................................................. 8
   5.1 Project Cycle Management ......................................................................................... 8
      5.1.1 Practical: Problem Analysis .............................................................................. 8
      5.1.2 Practical: Objective Analysis ............................................................................. 9
      5.1.3 Practical: Project Selection .............................................................................. 9
      5.1.4 Practical: Project Design Matrix ....................................................................... 9

6.0 Formation of a Regional Network of Aquaculture Organisations .................................. 9
   6.1 Summary ...................................................................................................................... 9
   6.2 Discussion ................................................................................................................... 10

7.0 Draft Idea for Master Plan for Regional Aquaculture Development ............................. 10
   7.1 Summary ...................................................................................................................... 10
   7.2 Discussion ................................................................................................................... 10

8.0 Potential Role of the University of the West Indies (UWI) in Regional Aquaculture
   Development .................................................................................................................... 10
   8.1 Summary ...................................................................................................................... 10
   8.2 Discussion ................................................................................................................... 11

9.0 National Aquaculture Development Plan ...................................................................... 11

10.0 Way Forward .............................................................................................................. 11

11.0 Closing Ceremony ..................................................................................................... 12

Appendix I: List of Participants ......................................................................................... 13
Appendix II: Workshop Agenda ......................................................................................... 14
Appendix III: Country Reports ............................................................................................ 16
Appendix IV: Project Cycle Management ............................................................................ 54
Appendix V: Problem Analysis ............................................................................................ 73
Appendix VI: Objective Analysis ........................................................................................ 79
1.0 Background
The aquaculture sector is not well developed in the CARICOM region, with significant development limited to countries like Jamaica and Belize. Other countries like Guyana, Suriname and Trinidad and Tobago have begun to put more emphasis on aquaculture as an area for development. The practices mainly involve the use of ponds to culture such species as penaeid shrimp, tilapia, carp and cachama. Also, there is long line culture for algae in St. Lucia and the mangrove oyster in Jamaica.

Most CARICOM States have limited land and fresh water resources, however some, like Belize, Guyana and Suriname, do have ample supplies. On the other hand, most states have larger expanses of marine space than land mass, which offers the potential for the promotion and development of mariculture. As such, the approach to aquaculture development will have to be multifaceted in its focus, design and implementation in order to address the needs of those with ample land and fresh water resources and those with less of these resource endowments. The CRFM has identified the promotion and development of aquaculture as one of the programme areas within its Strategic Plan and Medium Term Plans 2004/2007 and 2008/2011.

The CARICOM/CRFM/JICA Project: Study on Formulation of Master Plan on Sustainable Use of Fisheries Resources for Coastal Community Development in the Caribbean has been developed with the aim to conduct a study and formulate a Master Plan on the Sustainable Use of Fisheries Resources for Coastal Community Development in the Caribbean. It is being funded by JICA under the CARICOM/Japan Cooperation Agreement and is addressing the following components: (i) pelagic resource development and management; (ii) aquaculture development policy formulation; (iii) regional fisheries database development; (iv) support for community-based management; and (iv) education and training in the component fields in the CARICOM States. The expected outputs are: (i) a Master Plan on Sustainable Use of Fisheries Resources for Coastal Community Development in the Caribbean; (ii) reports of Baseline and Pilot Studies conducted under the various components; and (iii) transfer of relevant technology to the institutions and staff of CRFM Member States and CRFM Secretariat during the course of the Study.

Following on the First Project Steering Committee Meeting in December 2009, and subsequent communication among the CRFM and JICA/IC Net Ltd, three (3) pilot projects were selected for implementation in 6 countries between April 2010 and October 2011. The Pilot Projects and countries where they are being implemented are: (i) Fish Aggregating Device (FAD) and Associated Pelagic Fisheries Resources Development and Management (Dominica and St. Lucia); (ii) Development of Fisheries Statistical System Models (Guyana and St. Vincent and the Grenadines); and (iii) Small-scale aquaculture training (Jamaica) and low cost small-scale aquaculture development (Belize).

In relation to the Small-scale Aquaculture Training, two regional workshops are scheduled during the period of pilot project implementation; the first in March 2011 and the second in August 2011. The inter-sessional period will be used by participants to review and finalize, in consultation with the relevant stakeholders, the draft action plans for sustainable aquaculture development for the respective Member States.

This volume contains the report of the First Regional Workshop on Aquaculture Development Planning, held in Jamaica from 14 to 21 March 2011. The objective of the Workshop was to provide training in project cycle management, including problem analysis and planning, and to assist in the preparation of draft action plans for sustainable aquaculture development in Belize, Guyana, Haiti, Jamaica, Suriname and Trinidad and Tobago. The expected outputs are: (i) Draft Action Plans for Sustainable Aquaculture Development; and (ii) twelve fisheries officers trained in Project Cycle Management, including problem analysis and planning.
2.0 Workshop Arrangements
The participants, drawn from the CRFM Member States of Belize, Guyana, Haiti, Jamaica, Suriname and Trinidad and Tobago, introduced themselves; identified chairpersons for the various sessions on the Draft Agenda; and reviewed and adopted the Workshop Agenda. The full List of Participants is given at Appendix I and the Agenda appears at Appendix II.

3.0 Country Reports
Each Member State presented a report on the status of aquaculture development in their country. The reports sought to address such aspects as a brief history, importance of aquaculture, description, including production and other statistics; current situation - policy, laws/regulations, existing plans and level of implementation, budget allocation, including donor funded projects; lessons learned; and challenges and constraints to aquaculture development. Summaries from each country report and the subsequent discussions are given below. The Country Reports are provided at Appendix III.

3.1 Belize
3.1.1 Report summary
Aquaculture production in Belize began in the early 1980’s. Its (fisheries and aquaculture) contribution to GDP has varied from 5.0% in 2003 to 2.2% in 2008. The greatest financial investment and consequently production has been from shrimp farming, with 5 million pounds being produced in 2000, 18 million pounds in 2005 and 5.2 million pounds in 2008. The export values associated with such production were BZ$9.2 million in 2000, BZ$91 million in 2005, and BZ$25.6 million in 2008. The second most important aquaculture commodity in terms of production biomass has been tilapia, with production going from 571,000 pounds in 2005 to 4.1 million pounds in 2008 and 1 million pounds in 2010. Cobia (Rachycentron canadum) is the third most important aquaculture commodity in terms of production biomass, with 850,000 pounds being produced in 2008.

Apart from the industrial scale commercial oriented tilapia operations, a number of semi-commercial and small scale back-yard farming operations have developed in Belize. The latest statistics shows that there were 65 small scale operations with a cumulative pond production area of 16 acres. The harvests from these operations have been mainly for local consumption.

The Fisheries Department is responsible for regulating the aquaculture sub-sector in Belize, which in large measure entails the articulation of policy and legislation as well as providing advisory support to developers and training. It also involves the production of seed stocks to sustain the small-scale tilapia farming initiatives. At present, there is no official policy or industry specific regulation to guide the development of aquaculture in Belize.

The aquaculture sector continues to face such challenges as the sustainability of the various farmed commodities given the high cost of production inputs and unstable market prices. In terms of diversification from the traditional aquaculture activities in Belize, there has been a growing interest by investors in tilapia cage culture, sea cucumber aquaculture and the farming of seaweed (algae). With regards to investment opportunities, the Government of Belize continues to offer various tax and concessionary land offerings incentives to attract direct foreign investment in aquaculture development, with the competitive advantage of Belize being its proximity to major regional markets.

3.1.2 Discussion
Following on the presentation by the participants from Belize, questions and comments were entertained. Based on these discussions, it was noted that although there was a rebound in shrimp prices, some shrimp farm facilities have remained closed, with some facing foreclosure by the banks.
which were unwilling to write off outstanding debts. Banks with prior exposure were now reluctant to support further aquaculture investment.

It was pointed out that in order to avoid such financial difficulties, the banks and other investment agencies should develop their capacities to ensure sound project appraisal that is technically, economically and environmentally sustainable.

In response to queries concerning the development of the sub-sector, it was mentioned that offering a deregulated environment led to rapid, uncontrolled, unsustainable development which resulted in a possible boom/bust cycle. The roles of the Fisheries Department and Coastal Zone Management Authority in regulating the sub-sector were pointed out. It was indicated that as early as 2004, a draft national aquaculture policy and a draft aquaculture act, mainly industry inspired, were written. Unfortunately, they were never accepted due to possible sector self-interest and lobbying.

It was indicated that the environment NGO lobby in Belize was very influential and as such more rigorous and technically sound EIAs had to be undertaken as part of any aquaculture investment venture. The permit approval process often times acts as a disincentive to small scale farmers who are unwilling to go through the entire process given the low levels of production.

Among the other issues discussed were environmental outflow/loading associated with nutrient effluent; exposure to natural hazards and resource use competition. Also, it was noted that despite a precautionary approach to aquaculture development, the need to both generate and fast track investment and development projects could sometimes result in faulty decision making.

Exposure to natural hazards, specifically the threat of hurricanes and the relatively exposed nature of suitable sites, was identified as a major constraint for coastal aquaculture development, especially cage farming.

Insurance issues were raised but not fully explored. However, it was noted that possible risk exposure to natural hazards raised the reluctance of insurers to offer full or limited coverage to an aquaculture farm. On the other end, premium obligations of the insured could not be supported by their operations.

3.2 Guyana
3.2.1 Report summary
At present, there are forty-three (43) large scale producers most of whom reside on the coast of Guyana and approximately ninety-three (93) small and prospective aquaculture farmers. These farmers produce mainly red tilapia (Oreochromis spp.), Nile tilapia (Oreochromis nilotica), tambaqui (Colossoma macropomum), hassar (Hoplosternum littorale), black shrimp, mullet (Mugil cephalus), queriman (Mugil liza) and bashaw (Micropogonias furnieri). The industry can be considered to be growing through expansion of existing aquaculture farms and an increasing number of prospective farmers.

Aquaculture development is spearheaded by the Satyadeow Sawh Aquaculture Station (SSAS) of the Fisheries Department. The facility is used to execute research activities, train farmers, produce fingerlings and provides extension services to farmers. The Fisheries Department, through collaboration with agencies such as USAID Collaborative Research Special Project (CRSP) and the Brazil Technical Cooperation Agreement, has made some strides towards improving the development of the aquaculture sector in Guyana. However, there are certain key constraints that hinder the rapid development of the sector, namely:
- inadequate access to technical expertise and training to improve the technical capability of the technical staff of the Aquaculture unit,
- insufficient funding and research related particularly to quality feed formulation,
- unavailability of a suitable local feed,
- inadequate marketing of Guyana’s aquaculture products locally, regionally and internationally, and
- inadequate policy development and execution and incentives to further stimulate the sector.

3.2.2 Discussion
Based on the discussions following the presentations, it was noted that aquaculture development was slow and primarily at the extensive level. It was also pointed out that there were some farmers who breached the sea defenses to let in brackish water with juvenile fish and shrimp into primitively constructed grow-out areas. With Guyana being a low lying country, this breaching of the coastal defenses in some areas could pose a serious challenge to the coastal flood management systems which would in turn threaten human life, property and traditional rice farming activity. Salinization of lands with brackish water would over time render lands unsuitable for traditional agricultural production activity.

Some of the major challenges to aquaculture development were identified as:
- inadequate development policy and legislation
- high energy costs
- feed (high cost, low quality, poor shelf life)
- low level of private/foreign capital investment
- insufficient human capacity
- inadequate project evaluation processes
- inadequate arrangements/mechanisms for brood stock development and seed supply
- prædial larceny
- inadequate natural hazards risk management
- inadequate information sharing and dissemination.

It was also opined that insurance coverage should be provided in the aquaculture sector to address risks resulting from the increased frequency and severity of natural disasters; climate change; and prædial larceny. Reference was made to the recently concluded 2010 Antigua and Barbuda Symposium on Disaster Risk Management (DRM), the Caribbean Catastrophe Risk Insurance Facility (CCRIF) and the suitability of the WINCORP model for aquaculture coverage in the wider CARICOM region.

3.3 Haiti

3.3.1 Report summary
Haiti’s aquaculture is characterized by non-commercial subsistence scale activities with low input feed based, mostly for personal consumption or local sale. Tilapia is the main species used in aquaculture. Aquaculture (freshwater, brackish-water and marine) is very feasible in Haiti. There is good potential for aquaculture development in various zones in the country, with more than 23,000 hectares of land not suitable for agriculture being favorable for the development of commercial aquaculture fish farms.

In 2009, the government in Haiti, through the Ministry of Agriculture, Department of Fisheries and Aquaculture, established the necessary conditions for investment by the private sector in order to achieve increases over the next ten (10) years in the production of the marine fisheries from 16,000 tons to 35,000 tons; pond aquaculture from 400 to 5,000 tons, and inland water from 600 to 10,000 tons. They also intend to create 70,000 jobs during this development phase.

3.3.2 Discussion
Based on the discussions, it was indicated that Haiti currently has low levels of aquaculture production and is deficient in all inputs for development, except for favorable natural resources for
cage culture. Also, there is a need to provide for its nationals a guaranteed supply of affordable fish protein.

The country is currently benefiting from technical development assistance from Cuba, but has strong reservations regarding the roles of NGOs in their development processes.

It was mentioned that Haiti is quite open to external private sector investment, but lacks infrastructure and reliable public utilities which would pose development challenges. Despite the importance of aquaculture, there is competition for resources from several other sectors, especially since the earthquake.

3.4 Jamaica

3.4.1 Report summary

Jamaica is the third largest island in the Caribbean Sea. The main income generating sectors for the economy are exports of sugar, bananas, mining, tourism and remittances. However, recent contributions from the fishing industry, in particular aquaculture, have resulted in a 41.3% increase in contribution to GDP moving to 0.39%. Aquaculture production grew from 3,000MT in the 1990’s to 5,776 MT in 2009, with an estimated value of US$20 million. Some 300,000 persons benefit directly or indirectly from aquaculture activities.

Subsistence aquaculture was first introduced into Jamaica in 1948. However, commercial expansion of the industry began in 1976 through a USAID/GOJ project. Since 1976, the aquaculture sub-sector has grown steadily with production focusing on tilapia. At present, the industry includes an ornamental fish sub-sector, culture of marine shrimp (Penaeus vannamei) and freshwater crayfish (Macrobrachium rosenbergii), and small-scale production of the mangrove oyster (Crassostrea rhizophorae).

Despite the achievement in the industry, growth has been stymied due to competition from cheap imports from South East Asia, high input costs, high incidences of praeial larceny, high cost of credit, and the absence of a ratified policy and development plan.

3.4.2 Discussion

The Jamaica presentation was treated as a case study. However, it could be seen that it shared common challenges with the other countries such as:

- high production costs (energy, feed, seed, security)
- inadequate monitoring and enforcement
- inadequate extension support
- financing collateral requirements prevent uptake and stifle debt servicing
- absence of ratified policy and development plan
- poor cooperative structures/ unable to capitalize on cluster competiveness.
- availability of cheap imports
- susceptibility to natural hazards.

It was pointed out that the development followed somewhat the same trend as the Belize shrimp industry displaying the typical boom and bust cycle. However, as a way forward the industry needed to diversify along the following lines:

- species produced
- cooperative management approach
- cheaper production technologies.

In terms of the lessons learned, the following were stated:

- There should be a reliable public seed supply to ensure quality and market stability
- The need for an aquaculture one stop shop
- There should be product diversification to ensure wider market penetration
- There is need to develop and get buy-in to a policy /development plan in keeping with national policy direction.
- There is need for improved feed.

3.5 **Suriname**

3.5.1 **Report summary**

Suriname has been involved in aquaculture activities since the 1800’s. From that period to now there have been various studies and activities done in this field, but it was not until the 90’s that there was a significant increase of aquaculture farms. The majority of these farms have since gone out of production for various reasons, such as inadequate marketing, insufficient expertise, bad management and financial constraints. At present, there is only one commercial aquaculture farm in production that is supplying the local market, although it is certified to export its products to the EU.

There are several ongoing projects that are all receiving support (financial and/or technical) from the FAO. These are:

1) Rice-fish project in Nickerie
2) Aquaculture station project at Oryza
3) Development of a disease monitoring plan for aquatic animals.

In the development of the aquaculture sector, Suriname faces challenges and constraints such as:

- inadequate knowledge in the areas of cultivation, aquaculture engineering and marketing
- insufficient expertise
- financial constraint and high production costs
- insufficient means of export
- inadequate government support
- insufficient inputs (parental brood stock, fry, feed, nets, etc.)
- outdated investment legislation;
- insufficient and/or outdated information on aquaculture.

3.5.2 **Discussion**

Based on the discussions, it was noted that despite the existence of favorable natural resources, Suriname is characterized by relatively low levels of aquaculture development, with aquaculture for local consumption facing considerable competition from the abundance of wild catch.

The commercial operations that grew tilapia and marine shrimp lost market access to the EU due to the absence of the ability to conduct requisite product residue testing. Although, this capacity was later installed, the decline in global prices and competition from South East Asian suppliers prevented a rebound for local commercial aquaculture interests.

The matter of quality control and accompanying phyto-sanitary issues were raised given the common experience of the rigorous and costly approval process to access the EU market. As such it was noted that development planning must factor in the shift to traceability and an eco-based production approach (as determined by Global Gap, WWF) as these are rapidly becoming prerequisites for market access.

It was pointed out that integrated rice and fish farming activity with no chemical usage improved rice production due to the fish eating unwanted plant pests, so this offered some potential at the pilot level for eco-labeling of product. However, Guyana’s experience suggested that a careful approach to integrated rice fish culture activity would have to be taken as the larger scale rice farming operations tended to revert to pesticide use.
It was mentioned that although there was no clear policy for aquaculture development, the development process should center on the export market or on high value endemic and indigenous stocks both for food fish and ornamental production. There was also an acceptance of the fact that within the region many wild fish stocks are fully exploited and for some species overexploited and so the development of sound aquaculture technologies for traditional (commodities species) and other indigenous species represented a prudent and strategic plan for ensuring food sovereignty and diversification of the agricultural sector.

3.6 Trinidad and Tobago

3.6.1 Report summary
The history of Aquaculture in Trinidad and Tobago spans a period exceeding 60 years. Most attempts at commercial aquaculture have not been successful due primarily to improper planning, poor vision or scope, and inadequate or inconsistent management practices. The country has traditionally relied on fish caught from the marine environment to satisfy its fresh fish requirements. However, landings from marine fisheries have been decreasing whilst demands and prices for fish have been increasing. These factors have contributed to a resurgence of interest in aquaculture in Trinidad and Tobago. Other factors include global trends in demand and prices for fish, favorable economic climate, increased consumer acceptance and availability of technical information. However, with limited availability of suitable land for aquaculture, low availability of large quantities of suitable water on a continuous basis, the high cost of land, limited availability of dependable labor, high incidence of paedial larceny and general lifestyle changes have led to a paradigm shift in the traditional approaches and general thinking about aquaculture for the sector to be successful.

With an emphasis on addressing some of these issues, several models for tank based, intensive, re-circulating systems have been developed. Compared to extensive and semi-intensive earthen pond culture of fish, intensive aquaculture systems require small areas of land, low labor and water inputs, are easy to manage and secure but are relatively expensive to establish.

These models are being field tested to provide demonstration units and statistical and financial data to guide potential investors as well as farmers and financial institutions in decision making. Underpinning this strategy is commitment by the Fisheries Division for collaboration with key stakeholders in the sector to foster a better informed, organized and coordinated approach to the development of commercial aquaculture.

3.6.2 Discussion
Based on the discussions on the presentation, it was noted that despite several interventions within the food based aquaculture sector, it remained poorly developed in comparison to the ornamental fish sector.

In relation to the effectiveness of cross border bio-security screening and inspection, it was indicated that the Government’s veterinary division had been identified as the responsible agency.

It was mentioned that although there was no ratified aquaculture policy, a developmental model which seeks to capitalize on an intensive recirculation system to produce tilapia was now been investigated, through stakeholder consultation. Despite the fact that tilapia is regarded as a cheap fish protein source the justification for the capital intensive approach is based on the following issues:

- high land cost
- land based facilities require buffer zones especially with respect to chemical use
- low energy costs
- reluctance of youth to work in traditional pond culture.
A lack of inter-agency cooperation was identified as a drawback to the necessary coordination and analysis. However, preliminary analysis of the intensive culture system is generating interest and the government is currently designing a package of incentives to stimulate investor commitment. Aquaculture development, if seen within the context of food security, necessitates specially designed financial and development assistance.

It was opined that there was need for the establishment of a regional database for aquaculture information, with such a database being seen as critical to training, developmental direction, and problem solving. It was also mentioned that the University of the West Indies could play a support role in this area, especially as several research projects targeted to support aquaculture development at the various campuses have been done.

4.0 Field Trips
As part of the Workshop Agenda, participants were taken on field trips to the following aquaculture and ornamental fish farms:
- Ministry of Agriculture and Fisheries, Aquaculture Branch, Twikenham Park Caribbean Mariculture Farms, a commercial shrimp farm
- Branches Fish Farm, an ornamental fish operation
- YS Valley Farm, a small scale integrated aquaculture farm
- Aquaculture Jamaica Limited, a commercial tilapia farm.

During these visits, the participants were taken on tours of the farms by the farm owners and/or managers who explained about their operations and answered any queries posed by the participants.

5.0 Aquaculture Development Planning
5.1 Project Cycle Management
Mr. M. Iinuma, Aquaculture Consultant, IC NET Limited delivered an overview on the use of the Project Cycle Management (PCM) tool and indicated how it could be utilized in the analysis of the aquaculture situation in each country and the subsequent development of their respective Draft Aquaculture Development Plans.

PCM is a method designed to facilitate project development using a series of steps - Problem Analysis, Objective Analysis and Project Selection - to create a Project Design Matrix (PDM).

Prior to each planning session, Mr. Iinuma provided a detailed presentation on the area of PCM that was going to be covered. Then, participants working as country teams applied the particular component of the PCM tool to their country situation. The PowerPoint presentations on the respective areas of PCM are provided at Appendix IV.

5.1.1 Practical: Problem Analysis
The participants identified the main problems affecting aquaculture development in their respective countries. The cause and effect relationships among the problems were set out as a problem tree. The main point that came out from these sessions was that despite the differences in prior and existing development activities, the issues facing all countries were for the most part identical. Such common issues included inadequate aquaculture development policies, high cost of production, mainly due to high feed and energy prices, and praedial larceny. The Problem Analysis for each country is provided in Appendix V.
5.1.2 Practical: Objective Analysis
By reversing the negative statements in the Problem Tree into positive statements an Objective Analysis Tree was created for each country. This process aids in the identification of problem solving options. The Objective Analysis Tree for each country is provided in Appendix VI.

5.1.3 Practical: Project Selection
Based on the Objective Analysis, different approaches to realizing the core objective were identified. Comparisons were then made among the different approaches using such criteria as priority of development policy, financial/economical aspects, cost efficiency, technical and general feasibility, needs of target group and the environmental aspects. Each country selected a particular approach to develop a project.

5.1.4 Practical: Project Design Matrix
After the series of analyses had been completed, the participants moved to the next planning stage. Based on the particular Objective Analysis Tree, a PDM template (see Figure 1) was used to set out a concrete project. The template consists of a narrative summary, objectively verifiable indicators, and means of verification, pre-conditions, important assumptions and inputs. Due to the time constraints, only the narrative summary and inputs were prepared during the workshop, with participants being tasked to complete their country’s PDM in the inter-sessional period leading to the Second Regional Aquaculture Planning Workshop in August 2011.

Figure 1: Template of the Project Design Matrix (PDM)

<table>
<thead>
<tr>
<th>Project Title:</th>
<th>Target Group:</th>
<th>Version:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Area:</td>
<td>Project Period:</td>
<td>Date:</td>
</tr>
<tr>
<td>Narrative Summary</td>
<td>Objectively Verifiable Indicators</td>
<td>Means of Verification</td>
</tr>
<tr>
<td>Overall Goal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Purpose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outputs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activities</td>
<td>Inputs</td>
<td>Preconditions</td>
</tr>
</tbody>
</table>

The Project Design Matrix (PDM) for each country is provided in Appendix VII.

6.0 Formation of a Regional Network of Aquaculture Organizations
6.1 Summary
The Programme Manager, Fisheries Management and Development, made the presentation entitled “Formation of a Regional Network of Aquaculture Organizations”. In this presentation, he dealt with the definition of a network and the role it can play in building and cultivating relationships that provided one with a system to advance issues and meet specific needs. He then provided examples of regional and international networks such as LIAT, Al Qaeda and ICCAT.

Following on this he spoke about the Network of Aquaculture Centres in Asia and the Pacific (NACA) model, including the NACA Agreement, vision, structure, membership, partnership arrangements and core activities. Then, he outlined a proposal for the establishment of CARICOM/CRFM network of aquaculture organizations, including the likely objectives, composition and functions. The PowerPoint presentation on the Formation of a Regional Network of Aquaculture Organizations is provided at Appendix VIII.
6.2 Discussion
Based on the discussions following the presentation, it was opined that such a network would provide ample opportunity for regional cooperation and that it could be housed within the CRFM. It was recognized that funding for the operations of the network would have to be addressed, with it being mentioned that JICA could be seen as a source for support. As such, it was also suggested that the Proposal for the Network should be included in the CRFM Master Plan.

The participants requested that a concept paper on the Network be prepared by the PMFMD, and circulated for comments to the Workshop attendees before the follow-up Workshop in August 2011. It was also suggested that participants should play a role in sensitizing others to the goals, objectives and need for the Network.

7.0 Draft Idea for Master Plan for Regional Aquaculture Development
7.1 Summary
Mr. Udagawa presented the Vision, Goal, and the Strategy for the Master Plan for Regional Aquaculture Development. He indicated that aquaculture is being considered as an alternative income generating source for coastal communities. It could also be seen as a means of providing income opportunities for inland farmers and so limit the migration of farmers into coastal fisheries operations. The Presentation is provided in Appendix IX.

7.2 Discussion
Based on the discussions following the presentation, it was noted that while the focus seemed to be on small-scale aquaculture development, the policy orientation/platform should also support commercial activity. It was indicated that the plan dealt mainly with tilapia production and should be adjusted to include other species such as the common carp.

It was opined that a regional aquaculture policy/strategy should address common issues and provide the best means of addressing them along the value chain components. It was pointed out that for small-scale operators to move beyond producing for the local consumers, the issue of quality assurance would have to be addressed so that such operators can satisfy national, regional and international SPS requirements and be more competitive.

The participants indicated that there was need to clearly understand what was meant by small-scale aquaculture and tasked some of the workshop members with researching and defining small-scale aquaculture during the inter-sessional period. The group identified comprised of: Mr. D. Brown, Jamaica, Mr. H. Lalla, Trinidad and Tobago, Mr. G. Myvett, Belize and Dr. C. Phillips, UWI.

In terms of aquaculture research and development, it was opined that more attention should be paid to the culturing of endemic and indigenous species both in terms of food security and the preservation of biodiversity.

The need to develop alternative/indigenous feed sources especially for small scale aquaculture was seen as being critical. As such, it was suggested that this matter should be seen as a priority area and be included in the Master Plan.

8.0 Potential Role of the University of the West Indies (UWI) in Regional Aquaculture Development
8.1 Summary
The University of the West Indies (UWI) consists of 16 member countries in the English-speaking Caribbean, with main campuses located in Jamaica, Barbados and Trinidad and Tobago. UWI states
that its mission is “to propel the economic, social, political, and cultural development of West Indian society through teaching, research, innovation, advisory and community services and intellectual leadership”. It employs faculty with expertise in the fields of Engineering, Humanities and Education, Law, Medical Sciences, Pure and Applied Sciences, Science and Agriculture, and Social Sciences. As such, the UWI possesses a wealth of resources that could serve to support and promote regional aquaculture development by providing expertise in a broad spectrum of industry-related activities ranging from initial project feasibility studies to farm and resource management.

Key areas in which the UWI could play strong supportive roles include information and resource sharing, undergraduate/graduate education, applied research, needs-based projects, including project development/management/monitoring, professional training, provision of diagnostic services, sustainability and environmental impact assessments, policy development, technology development, continuing education and the establishment of cooperative linkages between researchers and private sector/governmental stakeholders. With its vested interest in regional advancement, the UWI seeks to be an asset to the regional aquaculture industry and will partner with industry stakeholders to strive toward sustainability of this sector. The presentation is provided at Appendix X.

8.2 Discussion
Following on the presentation and discussions, it was noted that UWI through its campus network and faculty specialization could assist in research and development; technology innovation, design and adaptation; and promoting youth involvement through formal education and project fairs.

9.0 National Aquaculture Development Plan
Under this agenda item, each country presented the outline of a draft aquaculture development plan, each of which was followed by discussions. The Country Presentations are provided in Appendix VII.

10.0 Way Forward
Participants outlined the activities to be done prior to the follow-up workshop slated for the end of August. These activities are as follows:

<table>
<thead>
<tr>
<th>Inter-sessional Activity</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completion of PDM/Approaches</td>
<td>April 30</td>
</tr>
<tr>
<td>Review of the aquaculture network concept paper</td>
<td>April 30</td>
</tr>
<tr>
<td>Compilation of Draft Aquaculture Development Action Plan</td>
<td>May 15</td>
</tr>
<tr>
<td>Definition of small scale aquaculture, etc. by working group (Dr. Ayanna C. Phillips, Mr. George Myvett, Mr. Dehaan Brown, Mr. Harnarine Lalla)</td>
<td>May 31</td>
</tr>
<tr>
<td>In-country stakeholder consultations on the Draft Aquaculture Development Action Plan</td>
<td>June 30</td>
</tr>
<tr>
<td>Revision of the Draft Aquaculture Development Action Plan</td>
<td>July 16</td>
</tr>
<tr>
<td>Establish Yahoo group for aquaculture group (Mr. Iinuma)</td>
<td>ASAP</td>
</tr>
<tr>
<td>Preparation and submission of progress report and revised action plan</td>
<td>July 31</td>
</tr>
</tbody>
</table>

It is expected that the inter-sessional activities will be completed as scheduled and the outputs of these activities will be presented and finalized at the Second Workshop on Aquaculture Development Planning, scheduled to take place during August 29-31, 2011 in Kingston, Jamaica. The workshop will receive and review: (i) the Progress reports which set out the steps taken, including any difficulties encountered, to develop the Revised Draft Aquaculture Development Action Plan (ii) the Revised Draft Aquaculture Development Action Plans (project design matrix and plan of operation) which would have been modified and refined by consultations and discussion with stakeholders in respective countries; and (iii) the progress report and results of pilot projects on aquaculture...
development in Belize (experiments on extensive fish culture) and Jamaica (training and extension of small-scale fish culture).

It was also suggested that the country participants for the follow-up workshop should be selected from among those who participated in this one so as to ensure continuity.

11.0 Closing Ceremony
At the end of the Workshop, closing remarks were made by the Director, Aquaculture Branch, Deputy Team Leader, IC Net Limited, CEO Fisheries Division, Jamaica and the PM FMD, with the participant from Guyana making the vote of thanks. The JICA representatives from Jamaica (Mr. Nishiyama) and CARISEC (Mr. Yoshida) were in attendance at the closing.
### Appendix I: List of Participants

<table>
<thead>
<tr>
<th>#</th>
<th>Country</th>
<th>Name</th>
<th>Position</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Belize</td>
<td>Mr. George Myvett</td>
<td>Senior Fisheries Officer</td>
<td><a href="mailto:georgemyvett@yahoo.com">georgemyvett@yahoo.com</a>, <a href="mailto:species@btl.net">species@btl.net</a></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Mr. Miguel Sosa</td>
<td>Assistant Fisheries Officer, Aquaculture Section</td>
<td><a href="mailto:aquaculturemiguel@yahoo.com">aquaculturemiguel@yahoo.com</a>, <a href="mailto:species@btl.net">species@btl.net</a></td>
</tr>
<tr>
<td>3</td>
<td>Guyana</td>
<td>Mr. Raulston Gillette</td>
<td>Fisheries Extension Officer</td>
<td><a href="mailto:raul_gih2000@yahoo.com">raul_gih2000@yahoo.com</a></td>
</tr>
<tr>
<td>4</td>
<td>Haiti</td>
<td>Mr. Jean Robert Badio</td>
<td>Director of Fisheries</td>
<td><a href="mailto:robertbadio@yahoo.com">robertbadio@yahoo.com</a></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Ms. Murielle Felix</td>
<td>Head of Aquaculture</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Jamaica</td>
<td>Ms. Avery Smikle</td>
<td>Director of Aquaculture Branch</td>
<td><a href="mailto:adgalbraith@gmail.com">adgalbraith@gmail.com</a></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Mr. Dehaan Brown</td>
<td>Senior Researcher</td>
<td><a href="mailto:brown1_de@yahoo.com">brown1_de@yahoo.com</a></td>
</tr>
<tr>
<td>8</td>
<td>Suriname</td>
<td>Mr. Rene B. L. Lieveld</td>
<td>Director of Fisheries (ag)</td>
<td><a href="mailto:reneblieveld@hotmail.com">reneblieveld@hotmail.com</a></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Dr. Anand Chotkan</td>
<td>Veterinary Officer</td>
<td><a href="mailto:a_chotkan@hotmail.com">a_chotkan@hotmail.com</a></td>
</tr>
<tr>
<td>10</td>
<td>Trinidad and Tobago</td>
<td>Ms. Christine Chan-A-Shing</td>
<td>Director of Fisheries</td>
<td><a href="mailto:cshing@malmr.gov.tt">cshing@malmr.gov.tt</a>, <a href="mailto:cchanashing@gmail.com">cchanashing@gmail.com</a></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Mr. Harnarine Lalla</td>
<td>Fisheries Officer</td>
<td><a href="mailto:h_lalla@hotmail.com">h_lalla@hotmail.com</a></td>
</tr>
<tr>
<td>12</td>
<td>CRFM</td>
<td>Mr. Terrence Phillips</td>
<td>Programme Manager, Fisheries Management and Development</td>
<td><a href="mailto:terrencephillips@vincysurf.com">terrencephillips@vincysurf.com</a></td>
</tr>
<tr>
<td>13</td>
<td>IC Net Limited/JICA</td>
<td>Mr. Kazuo Udagawa</td>
<td>Deputy Leader of the Study Team</td>
<td><a href="mailto:udagawa@icnet.co.jp">udagawa@icnet.co.jp</a></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>Mr. Mitsuo Inuma</td>
<td>Member of the Study Team</td>
<td><a href="mailto:inuma@icnet.co.jp">inuma@icnet.co.jp</a></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>Mr. Robin Hall</td>
<td>Project Coordinator, Pilot Project in Jamaica</td>
<td><a href="mailto:robinhall63@yahoo.com">robinhall63@yahoo.com</a></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>Ms. Natasha Clarke</td>
<td>Project Assistant, Pilot Project in Jamaica</td>
<td><a href="mailto:natasha.clarke@hotmail.com">natasha.clarke@hotmail.com</a></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>Dr. Ayanna Carla N. Phillips</td>
<td>Lecturer, UWI School of Veterinary Medicine</td>
<td><a href="mailto:phillipsacn@gmail.com">phillipsacn@gmail.com</a></td>
</tr>
</tbody>
</table>
## Appendix II: Workshop Agenda

<table>
<thead>
<tr>
<th>Date</th>
<th>Training Content</th>
<th>Venue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar. 13</td>
<td>Arrive in Kingston (Only Foreign Participants)</td>
<td></td>
</tr>
<tr>
<td>Mar. 14</td>
<td><strong>Opening of Training Program</strong></td>
<td>Hotel Four Seasons, Kingston</td>
</tr>
<tr>
<td></td>
<td>09:00 - 10:00 Opening ceremony</td>
<td></td>
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<tr>
<td></td>
<td>- Permanent Secretary of Ministry of Agriculture &amp; Fisheries</td>
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<tr>
<td></td>
<td>- Ambassador of Japan</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Representative of JICA Jamaica Office</td>
<td></td>
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<tr>
<td></td>
<td>- Chief Executive Officer / Director of Fisheries Division</td>
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<tr>
<td></td>
<td>10:00 - 11:00 Coffee Break</td>
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<tr>
<td></td>
<td>11:00 - 12:00 Course Orientation</td>
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<tr>
<td></td>
<td>12:00 - 13:00 Lunch</td>
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</tr>
<tr>
<td></td>
<td>**Session I : Country Report Presentation in Aquaculture Development (IC Net &amp;</td>
<td></td>
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<tr>
<td></td>
<td>CRFM)**</td>
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<tr>
<td></td>
<td>13:00 - 14:30 Country Report Presentation (2 countries)</td>
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<tr>
<td></td>
<td>14:30 - 15:15 Country Report Presentation (1 countries)</td>
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<tr>
<td></td>
<td>15:15 - 15:45 Coffee Break</td>
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<tr>
<td></td>
<td>15:45 - 17:15 Country Report Presentation (2 country)</td>
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<tr>
<td>Mar. 15</td>
<td><strong>Session II : Aquaculture Development in Jamaica (Fisheries Division Jamaica)</strong></td>
<td>Aquaculture Branch, Spanish Town</td>
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<tr>
<td></td>
<td>08:00 - 09:00 Move from the Hotel to Aquaculture Branch</td>
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<tr>
<td></td>
<td>09:00 - 10:30 Lecture: Aquaculture in Jamaica</td>
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<td></td>
<td>10:30 - 11:00 Coffee Break</td>
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<tr>
<td></td>
<td>11:00 - 12:30 Observation: Activities / Facilities of Aquaculture Branch</td>
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<tr>
<td></td>
<td>(Broodstock Culture, Monosex Fry Production, etc.)</td>
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<tr>
<td></td>
<td>12:30 - 13:30 Lunch</td>
<td></td>
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<tr>
<td></td>
<td>**Session III: Observation of Fish Farming in Coastal Areas (Fisheries Division &amp;</td>
<td>Fish Farms, St. Catherine</td>
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<tr>
<td></td>
<td>IC Net)**</td>
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<tr>
<td></td>
<td>13:30 - 14:00 Move to Old Harbour</td>
<td></td>
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<tr>
<td></td>
<td>14:00 - 16:00 Visit to Private Fish Farms in St. Catharine</td>
<td></td>
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<tr>
<td></td>
<td>16:00 - 17:00 Move from Aquaculture Branch to the Hotel</td>
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<tr>
<td>Mar. 16</td>
<td>**Session IV: Observation of Tilapia Farm and Ornamental Fish Culture in</td>
<td>Fish Farms, St. Elizabeth</td>
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<tr>
<td></td>
<td>Mountainous Areas (Fisheries Division &amp; IC Net)**</td>
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<tr>
<td></td>
<td>08:00 - 10:30 Move from the Hotel to St. Elizabeth</td>
<td></td>
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<tr>
<td></td>
<td>10:30 - 12:00 Observation: Commercial Fish Farm (Aquaculture Jamaica Ltd)</td>
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<tr>
<td></td>
<td>12:00 - 13:00 Move and Lunch</td>
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<tr>
<td></td>
<td>13:00 - 14:00 Observation: Small-scale Tilapia Farms</td>
<td></td>
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<tr>
<td></td>
<td>14:00 - 15:00 Move</td>
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<tr>
<td></td>
<td>15:00 - 16:00 Observation: Ornamental Fish Farms</td>
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<tr>
<td></td>
<td>16:00 - 18:00 Back to the Hotel</td>
<td></td>
</tr>
<tr>
<td>Mar. 17</td>
<td><strong>Session V: Approach to Aquaculture Development Planning (IC Net)</strong></td>
<td>Hotel Four Seasons, Kingston</td>
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<tr>
<td></td>
<td>09:00 - 10:30 Lecture &amp; Practice: Project Cycle Management</td>
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<tr>
<td></td>
<td>10:30 - 11:00 Coffee Break</td>
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<tr>
<td></td>
<td>11:00 - 12:00 Lecture &amp; Practice: Project Cycle Management</td>
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<td></td>
<td>12:00 - 13:00 Lunch</td>
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<td></td>
<td><strong>Session VI: Problem Analysis (IC Net &amp; CRFM)</strong></td>
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<tr>
<td></td>
<td>13:00 - 13:30 Explanation of Action Planning Process</td>
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<tr>
<td></td>
<td>13:30 - 15:00 Practice: Problem Analysis of Aquaculture Development in Respective</td>
<td></td>
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<tr>
<td></td>
<td>Country</td>
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<tr>
<td></td>
<td>15:00 - 15:30 Coffee Break</td>
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<tr>
<td></td>
<td>15:30 - 17:00 Practice: Problem Analysis of Aquaculture Development in Respective</td>
<td></td>
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<tr>
<td></td>
<td>Country (continue)</td>
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</tr>
<tr>
<td>Mar. 18</td>
<td><strong>Review and Revision of Problem Analysis</strong></td>
<td>Hotel Four Seasons, Kingston</td>
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<tr>
<td></td>
<td>09:00 - 10:00 Review and Revision of Problem Analysis</td>
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<tr>
<td></td>
<td><strong>Session VII: Objective Analysis (IC Net &amp; CRFM)</strong></td>
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<tr>
<td></td>
<td>10:00 - 11:00 Practice: Objective Analysis of Aquaculture Development in Respective</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>Session VIII: Action Planning of Aquaculture Development (IC Net &amp; CRFM)</td>
<td>Location</td>
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<tr>
<td>11:00 - 11:30</td>
<td>Coffee Break</td>
<td>Hotel Four Seasons, Kingston</td>
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<tr>
<td>11:30 - 12:30</td>
<td>Practice: Objective Analysis of Aquaculture Development in Respective Country (continue)</td>
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<tr>
<td>12:30 - 13:30</td>
<td>Lunch</td>
<td></td>
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<tr>
<td>13:30 - 14:30</td>
<td>Selection of Approach</td>
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<tr>
<td>14:30 - 15:30</td>
<td>Coffee Break</td>
<td></td>
</tr>
<tr>
<td>15:30 - 16:00</td>
<td>Coffee Break</td>
<td></td>
</tr>
<tr>
<td>16:00 - 17:00</td>
<td>Practice: Consideration of Program Purpose and Outputs</td>
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**Mar. 19 Sat**

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<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Location</th>
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<tbody>
<tr>
<td>09:00 - 10:30</td>
<td>Practice: Consideration of Activities and Inputs</td>
<td>Hotel Four Seasons, Kingston</td>
</tr>
<tr>
<td>10:30 - 11:00</td>
<td>Coffee Break</td>
<td></td>
</tr>
<tr>
<td>11:00 - 12:30</td>
<td>Practice: Consideration of Activities and Inputs (continue)</td>
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</tr>
<tr>
<td>12:30 - 13:30</td>
<td>Lunch</td>
<td></td>
</tr>
<tr>
<td>13:30 - 15:00</td>
<td>Preparation of Program Summary</td>
<td></td>
</tr>
<tr>
<td>15:00 - 15:30</td>
<td>Coffee Break</td>
<td></td>
</tr>
<tr>
<td>15:30 - 17:00</td>
<td>Preparation of Presentation Material</td>
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**Mar. 20 Sun**

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<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free Time</td>
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<td>Hotel Four Seasons, Kingston</td>
</tr>
<tr>
<td>Preparation of Presentation Material</td>
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</tbody>
</table>

**Mar. 21 Mon**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session IX: Action Planning Presentation (IC Net &amp; CRFM)</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:00 - 10:00</td>
<td>Draft Idea of Regional Master Plan in Aquaculture Development (IC Net)</td>
<td>Hotel Four Seasons, Kingston</td>
</tr>
<tr>
<td>10:00 - 10:30</td>
<td>Presentation &amp; Discussion : Action Plan of Aquaculture Development (1 countries)</td>
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</tr>
<tr>
<td>10:30 - 11:00</td>
<td>Coffee Break</td>
<td></td>
</tr>
<tr>
<td>11:00 - 12:30</td>
<td>Presentation &amp; Discussion : Action Plan of Aquaculture Development (3 countries)</td>
<td></td>
</tr>
<tr>
<td>12:30 - 13:30</td>
<td>Lunch</td>
<td></td>
</tr>
<tr>
<td>13:30 - 14:30</td>
<td>Presentation &amp; Discussion : Action Plan of Aquaculture Development (2 countries)</td>
<td></td>
</tr>
<tr>
<td>14:30 - 15:30</td>
<td>General Discussion</td>
<td></td>
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<tr>
<td>15:30 - 16:00</td>
<td>Coffee Break</td>
<td></td>
</tr>
<tr>
<td>16:00 - 16:30</td>
<td>Explanation: Activities after the Workshop</td>
<td></td>
</tr>
<tr>
<td>Closing of Training Program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:30 - 17:30</td>
<td>Closing Ceremony</td>
<td></td>
</tr>
<tr>
<td>- Chief Executive Officer / Director of Fisheries Division</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Representative of JICA Jamaica Office</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- CRFM Official</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Member of IC Net Team</td>
<td></td>
<td></td>
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</tbody>
</table>

**Mar. 22 Tue**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leave Kingston (Only Foreign Participants)</td>
<td></td>
<td></td>
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</tbody>
</table>
INTRODUCTION
The development of commercial aquaculture in Belize dates back to the early 1980’s when the farming of the Pacific White shrimp *Litopenaeus vannamei* was established through commercial experimentation. The success of this endeavor during the early phases of the industry led to the rapid expansion of shrimp farming to a total of 18 farms with a total production area of 6,888 acres in 2005. To date, seven farms remain operational with a production area of 3,082 acres. This is as a result of disease events and the major decline in global market prices in 2000 which continues to impact the financial sustainability of these operations.

By mid-2000, the species portfolio was expanded to the commercial production of Tilapia *Oreochromis niloticus* and Cobia *Rachycentron canadum*. Other species that have been attempted in the past were the culture of Red Fish *Sciaenops ocellatus*, African Lake Cichlids for the aquarium trade, Australian Red Claw *Cherax quadricarinatus*, Spiny Lobster *Panulirus argus* and the Queen Conch *Strombus gigas*. The most successful was the production of juvenile conchs between 1987 and 1992. The primary objective of the project was to develop laboratory techniques for the cultivation of Queen Conch larvae in an on-shore hatchery facility.

THE AQUACULTURE INDUSTRY IN BELIZE 2011

1. History of Aquaculture Activities in Belize
1.1. The Beginning of Belizian Aquaculture
Aquaculture in Belize formally began in 1982 with the development of ten (10) acres (4 Ha) of experimental ponds by a private company, in the southern part of the Country. Since that time, the industry has developed rapidly and has become firmly established as a significant contributor to the Belizean economy in terms of foreign exchange earnings, income generation, employment, nutrition, and food security.

In Belize, the aquaculture industry is primarily based on the production of the Pacific White Shrimp (*Litopenaeus vannamei*). Apart from the culturing of the exotic Pacific White Shrimp (*Litopeneaus vannamei*), the husbandry of other penaeid species has also been attempted in Belize. These include the exotic Pacific Blue Shrimp (*Penaeus stylirostris*), the exotic Giant Prawn of South-east Asia (*Penaeus monodon*), and the indigenous Caribbean White Shrimp (*Penaeus schmitti*). The culturing of these species had been attempted in the earlier phases of development of the industry. These trials however did not measure up to the expectations of producers and had been consequently abandoned.

Fresh Catch Belize Limited, the only commercial-oriented tilapia fish farming operation was formally inaugurated in December 2002. The facility has developed 150 acres (60.7 Ha) of production ponds. These facilities have a production capacity of 4,000 MT per annum with estimated annual revenues over Bz$12 million (US$6 Million).

Fresh Catch Belize Limited is based on the production of *O. niloticus* hybrids for the whole fish market and the fillet market. The farm is vertically integrated with production ponds, nursery systems, hatchery and processing facilities.
1.2. Other Farmed Species Attempted in the Past

Species that were tried in the past include the husbandry of: the freshwater Australian Red Claw Lobster (*Cherax quadricarinatus*), the Redfish (*Sciaenops ocellatus*), and a number of African Rift Lake ornamental finfish species such as *Haplochromis* sp., *Labeochromis* sp., *Melanochromis* sp., *Tropheus* sp., *Psuedotropheus* sp. and *Awlenocara* sp. and the Queen Conch (*Strombus gigas*). The most successful was the production of juvenile conchs between 1987 and 1992\(^1\). This initiative was funded by the USAID and the Government of Belize.

The primary objectives of the project were to:

a. Develop laboratory techniques for the cultivation of Queen Conch larvae in an on-shore hatchery facility;
b. Restock nearby conch habitats that have traditionally sustained viable conch populations; and
c. Conduct field exercises to estimate survival rates of hatchery reared juvenile conch.

The conch project in Belize was able to establish data in terms of the husbandry aspects from broodstock to juvenile stages. The hatchery process included the collection of egg masses from the wild, followed by laboratory rearing up to juvenile stages. Subsequently, juveniles were stocked in the wild and survival rates were monitored over a period of eight weeks. After a few years of experimentation, the project funds were limited which led to closure of the project.

2. Current Situation of Aquaculture Development

2.1. Shrimp Aquaculture

Although shrimp aquaculture expanded rapidly, shrimp farming operations experienced significant economic losses in the mid-1990’s and early 2000 as a result of pathogenic diseases and declining market prices. The first recorded episode of pathogenic disease impact in Belize occurred in July 1995, with the Taura Syndrome Virus (TSV). Mortalities associated with this disease were as high as 80 – 90\% in some locations.

In mid-2000 the Shrimp Farming sub-sector was also impacted by another viral disease, the IHHN Virus (Infectious Hypodermal Hematopoietic Necrosis Virus). In May 2001, the shrimp farms were again impacted by TSV\(^2\).

In addition to the economic losses as a direct result of pathogenic diseases, there was a decline in the global market prices for farmed shrimp commodities in 2000\(^3\) for the major market destinations of the USA, Japan and the EU. Since then, prices have not been favorable for producing countries such as Belize. The decline in shrimp prices is directly associated with the larger volumes of farmed shrimp exported by the Asian countries at very low prices.

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\(^1\) Mauro Gongora – Conch Hatchery Manager-Belize, 1987-1992  
\(^2\) 2002 Status of Aquaculture in Belize  
\(^3\) Figure 1: Farmed Shrimp Export & Value Trends
Given the various challenges in the shrimp farming sector, more than fifty percent of the production area has been out of production. In 2005, there were 18 shrimp farming operations with over 6,888 acres in production ponds. Over the last ten (10) years, eleven (11) shrimp farms have ceased operations. In 2010, there were seven (7) operating farms with a cumulative production pond area of 3,082 acres. Export volumes of farmed shrimp were reported at 2,280 metric tons valued at US$9.25 million in 2009. The main market destination for shrimp commodities is the Mexican market, followed by the U.S. and the CARICOM.

2.2. Tilapia Farming
Apart from shrimp farming, the commercial production of tilapia was established in 2002 by one commercial farm, namely Fresh Catch Belize Limited with 300 acres of production ponds in operation and total yields of 1,900 metric tons in 2009. The operation is vertically integrated with a hatchery and processing plant to compliment the pond production systems. First exports to the US market were made in mid-2004. This operation is currently being expanded by an additional 100 acres of production ponds. With the expansion, the total production capacity of Fresh Catch Belize Limited has been estimated at 4,000 metric tons per annum.

Table No. 1. Large Scale Tilapia Production from Belize

<table>
<thead>
<tr>
<th>Months</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>JAN</td>
<td>67.4</td>
<td>79.2</td>
<td>163.4</td>
<td>141.5</td>
<td>87.74</td>
<td></td>
</tr>
<tr>
<td>FEB</td>
<td>102.2</td>
<td>72.4</td>
<td>150.3</td>
<td>149.5</td>
<td>97.73</td>
<td></td>
</tr>
<tr>
<td>MARCH</td>
<td>86.6</td>
<td>118.5</td>
<td>192</td>
<td>177.7</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>APRIL</td>
<td>10.2</td>
<td>71.5</td>
<td>54.5</td>
<td>131</td>
<td>106.6</td>
<td>30.38</td>
</tr>
<tr>
<td>MAY</td>
<td>19.6</td>
<td>70</td>
<td>85.6</td>
<td>161</td>
<td>120.18</td>
<td>27.8</td>
</tr>
<tr>
<td>JUNE</td>
<td>28.5</td>
<td>70</td>
<td>79.7</td>
<td>171.4</td>
<td>123.1</td>
<td>24.7</td>
</tr>
<tr>
<td>JULY</td>
<td>34.8</td>
<td>70</td>
<td>80.3</td>
<td>175.7</td>
<td>87.4</td>
<td>11.7</td>
</tr>
</tbody>
</table>
The portfolio of products from Fresh Catch Belize includes both whole eviscerated fresh fish, as well as fresh frozen fillets. The fillets are destined for the US market, while the eviscerated fish is exported to Mexico and Guatemala. Fresh Catch Belize Limited is part of the ‘Mountain Stream Tilapia Alliance’, which is a conglomerate of fish farming companies from Costa Rica, Honduras and Belize exporting under one name brand.

### 2.3. Cobia Farming

The other commercial aquaculture venture is Marine Farms Belize Limited. The facility is the only commercial Cobia farming operation established in Belize. The operation is based on marine cage farming using Norwegian Technology. The operations are conducted near the Robinson Point Cays, which are comprised of cage infrastructure ranging from 5 meter circumference nursery cages as well as 40, 60 and 100 meter grow-out cages. The farm was established in 2006 and by 2007 exports were initiated to the US market through a marketing company by the name of AQUA GOLD. The products exported are ‘bullet’ cuts whereby the head is removed and the fish is gutted. The production capacity during phase I & II of the operations has been projected at 2,000 metric tons per annum. In 2008, cobia whole fish production was 384.4 metric tons.

Marine Farms has fully established a hatchery operation near Dangriga. The broodstocks in the hatchery have been sourced locally and the first spawns were realized in July, 2009. The production capacity of the hatchery has been estimated at one (1) million fingerlings per annum.
2.4. Small-scale Aquaculture

The history of the early phases of small-scale inland fish farming in Belize as well as its socio-economic contributions remains undocumented. Rural fish farming has been practiced in Belize on an experimental basis since the early 1990’s. This has been mainly in the form of backyard farming operations with a focus on locally occurring Cichlids species. These species include: the Bay Snook (Petenia splendida), Crana (Cichlasoma urophthalmus), Mus-Mus (Cichlasoma friedrichstali), Tuba (Cichlasoma synspilum) as well as the exotic Tilapia (Oreochromis niloticus).

Table No. 2. Summary of small scale Tilapia farms in Belize 2010

<table>
<thead>
<tr>
<th>District</th>
<th>Number of farmers</th>
<th>Total Fish Stocked</th>
<th>Production Area (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corozal</td>
<td>16</td>
<td>64,000</td>
<td>3</td>
</tr>
<tr>
<td>Orange Walk</td>
<td>12</td>
<td>35,000</td>
<td>2</td>
</tr>
<tr>
<td>Belize City</td>
<td>14</td>
<td>67,500</td>
<td>6.28</td>
</tr>
<tr>
<td>Stan Creek</td>
<td>6</td>
<td>9,000</td>
<td>0.76</td>
</tr>
<tr>
<td>Toledo</td>
<td>12</td>
<td>15,000</td>
<td>0.56</td>
</tr>
<tr>
<td>Cayo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grand Total</td>
<td>60</td>
<td>190,500</td>
<td>12.6</td>
</tr>
</tbody>
</table>

More recently, farmers have focused much interest in the farming of the red hybrid tilapia given the growth performance and local market demands. In 2009, there were a total of 55 farmers engaged in small-scale tilapia farming with a total area of 14 acres of production units ranging from 0.01 acres to 0.25 acres.

The Ministry of Agriculture & Fisheries’ Biscayne Fish Farm & Hatchery Facility provided in 2010 over 100,000 all-male tilapia fingerlings for rural farmers.

3. Problems and constraints of Aquaculture Development

3.1. Feed Production

Although much of the feed for shrimp farming has been manufactured in Belize over the past 10 years, a significant quantity of feed continued to be imported from the USA, Guatemala and Honduras over the past years. It has been mentioned by various farm managers in the sector that the quality and quantity of feed produced locally were not meeting the requirements of the industry. The management of Belize Mills Limited has been working over the past years on improving feed quality and has resulted in reduced imports from the neighboring countries.

To date, the Feed Mill does not have the capacity to supply the needs of the aquaculture industry. In the short-to-medium term, it is envisioned that the in-country manufacturing of feed will remain fairly stable.

Also, floating fish feed is not produced in Belize and thus is a limiting factor to the growth of the small scale fish farming sector. All floating fish feeds used in the commercial and small scale fish farms has to be imported from Guatemala, Honduras or Mexico. This fact makes the supply unstable and costly. Floating fish feed in Belize is more costly per pound that sinking shrimp feed. Some small scale farmers have no other choice than to cultivate their crops with sinking shrimp feed.

3.2. Financing for Small & Medium Scale Aquaculture Project

The number of operational small and medium scale fish farms has not increased over the last two years in Belize due to the lack of attractive loan/financing plans in the country for aquaculture. Private financial institutions do not offer loans designed for the small and medium scale fish farmer. Fish farmers can only make loan payments at the end of grow out cycles which is when fish is sold on
the local market. Finally, the loan interest rates of 11% are currently too high for most small-scale fish farmers to afford.

3.3. Lack of Proper Marketing Facility

Belizean small and medium scale fish farmers complain of the lack of a seafood marketing facility. Farmers do not have a proper marketing and storage facility equipped with stalls for the wholesale and retail of aquatic and seafood produce. This facility must also be equipped with ice factories where flaked ice can be bought, and cold storage rooms where produce can be stored until sales are completed.

The marketing system itself needs to be organized. Farmers often find themselves selling directly to restaurants. Buyers often complain of sporadic and inconsistent supply. Finally, ‘middlemen’ often complicate the marketing system by selling fillet tilapia at the same price of fillet snapper which unfortunately influences buyers to prefer the saltwater species of fishes over the freshwater species.

4. Existing Projects / Programs for Aquaculture Development

4.1. OSPESCA

Through the Organization of Fisheries and Aquaculture in Central America (OSPESCA) being funded by the Government of the Republic of China (Taiwan), there are currently various activities that are been implemented in order to further strengthen the sustainable development of aquaculture in the region. An aquaculture working group has been established in early 2010 to coordinate the various activities.

Thus far, there has been a regional forum on aquaculture which was held in Panama in April, 2010 in which member countries presented the emerging trends with regards to successful projects in aquaculture. Through this initiative, some of the key issues affecting the development of aquaculture were discussed with the purpose of developing future plans to advance the development of aquaculture in the region.

Within Belize, OSPESCA plans to implement in 2011 a project which will provide an alternative source of income to fisher folk of the New River Lagoon through aquaculture. This is Belize’s largest fresh water lagoon and spans 3 three miles in length and 1 mile in width. The Project will work in two fishing villages and provide tanks, tilapia fingerlings, fish feed and technical assistance to fishing families that dwell on the shores of the lagoon. The project aims to assist fishers to feed their families while at the same time reduce the fishing effort on the New River Lagoon ecosystem.

4.2. JICA/CRFM

The CARICOM Regional Fisheries Mechanism is currently finalizing a Master Plan on sustainable Use of Fisheries Resources for Coastal Communities with support from the Japanese International Cooperation Agency. Under this initiative, there a various pilot projects being implemented. The results gathered during the study will be utilized in the finalization of the Draft Master Plan to be completed in February, 2011. One of the pilot projects is being implemented in Belize. This pilot project is focusing on developing low-cost alternative feeds for small-scale tilapia farming in Belize. The project was started in mid 2010 and will be completed in mid 2011. The project is being carried out at the Belize Fisheries Department’s Fish Farm and tilapia Hatchery Facility.

5. Future Activities

The aquaculture sector continues to have its own challenges in terms of the sustainability of the various farmed commodities given the high cost of production inputs and unstable market prices. Shrimp producers are currently taking advantage of the high end markets and existing whole shrimp market in Mexico, and other niche markets in the E.U. and the CARICOM. For the tilapia sector, the Mexican and Guatemalan markets are also available for whole fresh fish and the U.S. market for fresh
fillets. The future expansion of Cobia aquaculture has been mired due to the limited supplies of hatchery-reared fingerlings. The company is therefore requesting the necessary permits to embark in the reproduction of other Atlantic finfish species such as snapper, Jack, etc. It is their hope that by diversifying their line of products that financial stability of the company can be secured.

In terms of diversification from the traditional aquaculture activities in Belize, there has been a growing interest by investors in tilapia cage culture, sea cucumber aquaculture as well as the farming of seaweed.

With regards to investment opportunities, the Government of Belize continues to offer various development incentives for aquaculture. The competitive advantage of Belize is the proximity to the regional markets for supplying fresh products to the U.S. markets.

BIBLIOGRAPHY
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Introduction
Aquaculture development is spearheaded by the Satyadeow Sawh Aquaculture Station (SSAS) of the Fisheries Department. The facility is used to execute research activities, train farmers and produce fingerlings. The SSAS also provides extension services and free technical advice to farmers.

The Satyadeow Sawh Aquaculture Station was constructed with funding provided by the Government of Guyana, the Food and Agriculture Organization of the United Nations (FAO) and the Canadian International Development Agency (CIDA). The station provides information on site selection, pond preparation and farm management. Technology transfer and training are offered to the local farmer. The facility is also involved in the production of fingerlings of various species, and conducts trials on feeding, growth rates, and other parameters regarding species with aquaculture potential.

The Department of Fisheries continues to maintain and upgrade the Satyadeow Sawh Aquaculture Station and its extension services. Recently an excavator and vehicle was acquired for the unit to assist farmers in pond construction and to increase the extension services provided to farmers.

In Guyana the following species have been taken into consideration and are currently being produced throughout the coast and some inland regions of Guyana namely the Rupununi areas:

1. Red tilapia Oreochromis spp
2. Nile tilapia Oreochromis nilotica
3. Tambaqui Colossoma macropomun
4. Hassar Hoplosternum litorale
5. Arapaima Arapaima gigas
6. Swamp Shrimp (Penaeus subtilis),
7. Mullet (Mugil cephalus),
8. Queriman (Mugil liza)
9. Bashaw (Micropogonias furnieri)

Objectives
To ensure that aquaculture is developed in a sustainable and controlled manner optimizing economic and environmental benefits.

Key Responsibilities

1. Maintain and operate the Anna Regina Fish Culture Station, with the intention of establishing other stations to provide seed stock to farmers and to serve as centers for technical excellence.
2. Co-ordinate the development of the aquaculture industry at the national level.
3. Identify species to be cultured based on scientific information.
4. Collect and obtain disease free specimens for culturing.
5. Establish culture systems to determine food requirements, growth rates, environmental and tolerance, and rates of reproduction.
6. Identify incentives that will facilitate growth of the aquaculture industry.
7. Collaborate with other agencies regarding the development of aquaculture and use of resources.
Scientific Studies
At present collaborative studies are being and have been done with the Guyana School of Agriculture so as to improve the state of aquaculture in Guyana along with those carried out by the Aquaculture unit.
They studies are as follows:
1. A comparative study between the weight gain of red tilapia (Oreochromis sp) using three feeding regime.
2. To evaluate the effectiveness of bio-foul and stocking density on the growth rate of red tilapias (Oreochromis sp.).
3. Evaluate the growth rate of red tilapia (Oreochromis sp) using chicken grower and locally produced fish feed.
4. Comparison of the growth rate between Red Tilapia (Oreochromis spp) and Nile Tilapia (Oreochromis niloticus) in a controlled environment.
5. Evaluating the growth rate, feed conversion ratio and mortality of the Oreochromis sp. using Rangen feed. This experiment is still on-going.

Background
Brackish Water Culture Potential
The brackish water activities involve the legal or illegal opening of the sea defense. Subsequently, taking advantage of the tidal inflows of high tides, juveniles, larvae, eggs, etc, are trapped in the coastal empoldered swamps and in some cases, specially constructed impoundments near the foreshore, where they are allowed to manure to marketable size.

It is recognized that brackish water farming activities make a great contribution to the livelihood of persons in Region 6, who depend on the yields of these farms for primary and secondary income, as well as a source of protein. Presently, there are two thousand one hundred and sixty-five (2165) acres of brackish water land under cultivation while there are two hundred (200) acres of freshwater land under Tilapia (Oreochromis sp) cultivation.

Many species are contained in the seawater that is trapped. Some of the targeted ones are Swamp Shrimp (Penaeus subtilis), Mullet (Mugil cephalus), Queriman (Mugil liza) and Bashaw (Micropogonias furnieri).

The Swamp Shrimp (Penaeus subtilis), Mullet (Mugil cephalus), Queriman (Mugil liza) and Bashaw (Micropogonias furnieri) are cultured in the same ponds but are harvested separately. The Mullet (Mugil cephalus), Queriman (Mugil liza) and Bashaw (Micropogonias furnieri) are not shrimp predators, and fetch a high price at the local market.

For the local market, partial harvest is practical, since the amounts of shrimps that are required are captured, and the rest of the shrimp population remains in the pond.

An interesting characteristic of the market is that most of the shrimps are sold at a juvenile stage (between 2.0 to 8.0 grams), and the price is more related to the shrimp color than to their size. The smaller and darker the shrimps are, the higher the prices as compared to the large white ones.

Total value of aquaculture production is estimated at three hundred and sixty six million three hundred and eighty eight thousand seven hundred and fifty nine ($366,388,759) dollars.

Super-males
Presently, the YY super-males (Red Tilapia Oreochromis spp) are being used for fry production. These super-males produce approximately 99% all male fingerlings which ensure uniformity as it
relates to growth and size in the production life of the animals. The problem of unwanted breeding is also to a great extent reduced thus ensuring as stated before uniformity in growth, reduction in the instances of overstocking, uniformity in size at market weight and the efficient utilization of feed. It should be noted that the YY super-males utilized are imported due to the fact that Guyana does not have the necessary infrastructure to produce these fishes.

We are strongly considering the use of the YY super-male (Nile Tilapia Oreochromis nilotica) for the production of the Nile tilapia so as to diversify our aquaculture production and capabilities.

Besides the Satyadeow Sawh Aquaculture Station there are approximately four (4) other major producers of fingerling to be fed into the grow-out system.

Japan International Cooperation Agency (JICA Technical Cooperation)
Mr. Thom, JICA Consultant, was attached to the Satyadeow Sawh Aquaculture Station; he also did part time lectures at the Guyana School of Agriculture. Mr. Thom reviewed the brackish water techniques in Guyana and assisted in the identification of the brackish water shrimp species. However his period of attachment to the Aquaculture Station has been completed and he has been replaced by Dr. Shozo Yamamoto who specializes in aquaculture more specifically fish diseases. He is also going to assist in part time lectures at the Guyana School of Agriculture.

Brazil Technical Cooperation Agreement
The Ministry of Agriculture (Guyana) had signed an agreement with Agencia Brasileira de Coopercao (ABC), “Technique Transfer to Contribute towards the Development of Aquaculture Sector in Guyana”. The first series of training was conducted in Guyana during the 14th -17th July 2010. The Brazilians trained the technical staff on the theoretical aspects of Tambaqui and Arapaima Production. The training is on-going and will strengthen the physical and human infrastructure of the Satyadeow Sawh Aquaculture Station (SSAS) so that they can fulfill the objectives of the aquaculture station and also improve the Aquaculture Sector.

Collaborative Research Special Project (CRSP)
During the 2nd – 10th August 2010 Dr. Kevin Fitzsimmons and Dr. Jason La Camele representatives from CRSP Project the visited Guyana. The CRSP Representative also conducted a two day training course on Hassar (Hoplosternum littorale) and Tambaqui (Colossoma macropomum) Production at Bina Hill Technical Institute, Bina Hill, Annai, and Region #9.

Current situation
At present there are forty three (43) producers who regularly supply their production data to the Ministry of Agriculture Fisheries Department. Most of these producers reside on the coast of Guyana particularly Region 1 Barima-Waini, Region 2 Pomeroon-Supenaam, Region 3 Essequibo Islands-West Demerara, Region 4 Demerara-Mahaica, Region 5 Mahaica-Berbice, and Region 6 East Berbice Corentyne.

These farmers produce mainly:
- Red tilapia Oreochromis spp
- Nile tilapia Oreochromis nilotica
- Tambaqui Colossoma macropomum
- Hassar Hoplosternum littorale
- Shrimp
- Mullet (Mugil cephalus),
- Queriman (Mugil liza)
- Bashaw (Micropogonias furnieri)
These farmers are involved in both brackish and fresh water culture and a large portion of the production is sold locally in their respective villages as fresh products and a portion is either processed and sold packaged in various supermarkets or sold directly to hotels and restaurants for preparation for guess.

There are also approximately ninety three (93) and counting small and prospective aquaculture farmers who require the aid of the technical staff of the Ministry of Agriculture Guyana to guide them along as they as they endeavor to start or as the case might be increase their level of production thereby contributing to the overall good of the country.

As it relates to production the Black Shrimp and Tilapia have the highest recorded total production with figures of 61,642,503.08 kg and 17,041,976.60 kg respectively.

As it relates to demand there has been a gradual increase particularly in 2010 and this was brought about through the promotion of aquaculture and its products by the Ministry of Agriculture Guyana through the Grow More Food Campaign and the establishment of the Agriculture Export Diversification Project which encouraged the establishment of commercial aquaculture farms to meet international export standards and thus bring in much needed foreign exchange into the country.

Lessons learnt

1. In any aquaculture operation no matter the species or condition it is important that as much as possible a well balanced diet be made available. This in turn helps to speed up the overall growth rate, thereby shortening the production period thereby bringing the organism or animal to market weight earlier as subsequently reducing the overall cost of production thus increasing the profit margin.

2. The importance of good site selection as it relates to water availability, security (theft, and predators and flooding) and access to market.

Constraints Commonly Faced

- Access to technical expertise and training to improve the technical capability of the technical staff of the Aquaculture unit.
- The need for funding for aquaculture related research in Guyana.
- Unavailability of a suitable local feed.
- El Nino conditions resulting in decreased water supply, high mortality of fingerlings.
- La Nino conditions where which results in flooding in some coastal areas of Guyana.
COUNTRY PROFILE

Background: Haiti is located between Cuba to the Northwest, Jamaica to the Southwest, Puerto Rico to the East, Bahamas to the North, and Colombia to the south. Haiti is bounded on three sides by water. To the North by the Atlantic Ocean, to the south by the Caribbean sea, and to the west by the Windward passage.
DEMographics

Haiti total area : 10,714 sq miles (27,750 Km2)
Land area : 27,560m2
Sea area : 190 km
Population : 10,000,000 with an average annual increase of 1.8%
Capital : Port au Prince, with 4.5 millions
Administrative : Ten (10) Departments:
Climate : Tropical climate with medium temperature 70 to 80 degrees Farenheit or 25 to 28 Celsius.
Rainfall : Annual rainfall varies from a high of 3,600 mm to a low of 600 mm. The rainy season begins in October and continues till December.
Literacy Rate : 53%
Education : By law, education is free and compulsory in Haiti for children between the ages of 7 to 13. However, access to that free education is limited to many people due to insufficient financial resources for parents to purchase the required school books and uniforms.

OVERVIEW ON AQUACULTURE IN HAITI

Coastline : 1,535 km to 1770 km
Fishers population : 52,000 fishers (part time and full time)
Fisheries production : 16,500 tons (600 tons of lobsters; 200 tons of lambi and 50 tons of shrimps representing about 95% of Haiti fisheries production; value 54 millions of dollars $ US representing 1.5% of the PIB)
Imports : 12,500 tons per annum to satisfy the local demand.
Aquaculture production : 400 tons (mostly tilapia and carp)
Continental production : 600 tons (more than 22,000 ha of body of water)
Hatchery production : 3.5 millions of fingerlings per year
Cage production : 160 tons
Consummation per capita : 4.5 kgs per annum
LAND & CLIMATE CONDITIONS

Haiti presents ideal climatic conditions for the development of aquaculture. There is great potential for aquacultural development in various zones in the country. Throughout the ten (10) departments in the country, more than 23,000 hectares of land unsuitable for agriculture are very favorable for the development of commercial aquaculture fish farms.

CURRENT PRODUCTION

Currently aquaculture in Haiti is characterized by a non-commercial subsistence scale, low-input, feed-based activities mostly for personal consumption or local sale.
The Direction of Fisheries and Aquaculture of the Ministry of Agriculture which is the body of the government responsible for the development of aquaculture in Haiti is trying through a technical cooperation with some Cuban experts to increase the production in ODVA hatchery and create new centers of fingerlings production.

EMERGING PARTNERSHIPS

OBSTACLES:

- Lack of seedstock (for fresh or marine water)
- Lack of agricultural products for feedstock
- Low level of production and lack of commercial approach
- Lack of infrastructure development and services
- Scarcity of people with adequate training and experiments
- A model of aquaculture farm with proven profitability.
- No credit available
- Lack of information (limited data collection)
- Lack of research in the viability of aquacultural development in Haiti
In 2009 the government of Haiti through the Direction of Fisheries and Aquaculture of the Ministry of Agriculture brought together private-sector players, officials, professors, and others interested parties to investigate the development of aquaculture in Haiti. This committee proposed the following steps:

- Conducting a study on the revision of commercial trade policy
- The inventory all existing aquaculture activities in the country
- Exploration of mechanisms for promoting modern aquaculture.
- Evaluation of resources and aquaculture potential
- Conducting studies on conservation, transformation, and commercialization
- Production of fish feed
- Stocking of bodies of water
- Establishment of farms & production in cages and ponds
- Increased production in existing hatcheries
- The creation of new centers of production
- Rehabilitation of farms with established potential
- Training and technical assistance for fish farmers
- Monitoring and evaluating activities.

CONCLUSIONS

Aquaculture (freshwater – brackish – marine) is very feasible in Haiti. There is a real potential for the development of this sub-sector. The program outlined in this presentation will help create the necessary conditions for investment by the private sector in order to achieve in the next ten years the production of the marine fisheries from 16,000 tons to 35,000 tons with pond aquaculture production increasing from 400 to 5000 tons and the inland water production from 600 to 10,000 tons.

The lines of action defined in this program will support the government particularly the Directorate of Fisheries and Aquaculture (DPAQ) of the Ministry of Agriculture and Natural Resources to better understand and manage resources, boost the sector, and contribute to achieving the millennium development goals—including food security, the fight against poverty, and the reduction of the risk of natural disasters in the sector.
Thus, on behalf of the Government of Haiti, we would like to ask that all future action taken in the sub-sector of aquaculture be based on the government program for a better implementation and control (planning and decision-making) of all resources in order to avoid costly, unresearched, poorly-planned, and poorly-executed “duplicate activities” in the sector.

MESI BOKOU
JAMAICA COUNTRY REPORT

1.0 INTRODUCTION
Subsistence aquaculture was first introduced into Jamaica in 1948; however, commercial expansion of the industry began in 1976 through a USAID/GOJ project. Since 1976, the aquaculture sub-sector has grown steadily with production focusing on tilapia. To-day the industry has grown in scope to include an ornamental fish sub-sector, culture of marine shrimp *Penaeus vannamei* and freshwater crayfish *Macrobrachium rosenbergii*, as well as small-scale production of the mangrove oyster, *Crassostrea rhizophorae*.

In 2010 the industry was valued at US$20M with some 300,000 persons benefiting directly or indirectly.

2.0 GEOGRAPHY AND ECONOMY
Jamaica is the third largest island in the Caribbean Sea. It is located 898 kilometres southeast of Miami, 144.8 kilometres south of Cuba and 160.9 kilometres south west of Haiti and possesses national land area of 10,991 square kilometres and a coastline approximately 891 kilometres long. Jamaica is an Archipelagic State and as such its territorial waters cover an area of 12,000 square kilometres with a further 274,000 square kilometres appropriated as its Exclusive Economic Zone (EEZ). The diverse stock of flora and fauna found in these waters are of significant importance to the country’s vibrant fishing industry.

Jamaica’s population grew by 0.5 % to an estimated 2,624,700 in 2002 over estimates for 2001. Since 2007 Jamaica’s economy has contracted with no growth in Gross Domestic Product (GDP). The employable labour force was 1,124.5M at the end of 2002 of which 15.4% are unemployed. The main income generating sectors for the economy are agricultural exports, including sugar and bananas; bauxite mining; and tourism. In addition, remittances from North America and the United Kingdom have played an increasingly significant role in recent times.

3.0 HISTORY OF FRESHWATER AQUACULTURE IN JAMAICA
Earliest records have revealed that Tilapia mossambica was introduced into Jamaica in the late 1940's. A breeding programme was started and the species was stocked in most major rivers and ponds. The
tilapia, locally known as African perch, soon became part of the local inland and brackishwater fisheries.

In October 1976 USAID and the Government of Jamaica started a project designed to promote inland fish culture. The following year the Government created the Inland Fisheries Unit (IFU) in the Ministry of Agriculture. The Unit was staffed by faculty members of Auburn University, Alabama, USA and local scientist.

In 1979, there were only fifteen subsistence fish farmers with ponds, excavated by hand, and having a combined area of only 0.1 ha. Farmers with ponds large enough to be commercially viable numbered 7 with a total of 3 ha. In 1980, when the IFU Extension Programme was expanded and the general public became aware of the potential of fish husbandry, a total of 28 farmers with 38 ponds totaling 14 ha were put into commercial production.

4.0 CURRENT SITUATION
A survey conducted by the Fisheries Division, Aquaculture Branch in March 2010 revealed that they are 183 fish farmers in Jamaica with total acreage of 2500.17. However, of this amount only 55.3% or 1,382.06 acres are currently in production. The industry is male dominated with females accounting for 8% of total framers. Culture occurs in earthen ponds ranging in size from 0.5-1.5 acres. Production methodology is extensive and semi-intensive with stocking rates for tilapia of 10,000-20,000 fingerlings per acres, respectively. Fish production is concentrated in the parishes of Clarendon, St. Catherine and St. Elizabeth; which accounts for approximately 90% of total production.

The average total capital investment in a Jamaican tilapia farm is approximately J$1,030,000 or US$11,976.74 and the estimated total cost of production is J$102.00 per pound or US$1.19. Profit margin range from a low of 15% to a high of 40%.

4.1 Production Statistics
Aquaculture production in Jamaica is centered on tilapia and shrimp with per capita consumption averaging 16.3kg/yr. Production has averaged around 5,200MT for the last eight years. The table below represents aquaculture production in Jamaica from 2001-2009.

<table>
<thead>
<tr>
<th>Year</th>
<th>Production (Shrimp and Tilapia) (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>5,000</td>
</tr>
<tr>
<td>2002</td>
<td>6,000</td>
</tr>
<tr>
<td>2003</td>
<td>4,350</td>
</tr>
<tr>
<td>2004</td>
<td>4,200</td>
</tr>
<tr>
<td>2005</td>
<td>5,670</td>
</tr>
<tr>
<td>2006</td>
<td>7,543.35</td>
</tr>
<tr>
<td>2007</td>
<td>5,600</td>
</tr>
<tr>
<td>2008</td>
<td>5,300</td>
</tr>
<tr>
<td>2009</td>
<td>5,776</td>
</tr>
</tbody>
</table>

4.2 Importance of Aquaculture
In 2009 the Fishing Industry in Jamaica contributed $3,741.3 (current prices) million to the Gross Domestic Product. This represented 6.37 percent of the output of the Agriculture, Forestry and Fishing sector and 0.39 percent of GDP. The 2009 output represented almost a 41.3 percent increase in the GDP of the industry, moving from $2,647.0 million in 2008. The increase in the output of the fishing industry reflects increased production of fish farms, as well as export-oriented fisheries which produce mainly shellfish such as lobster and conch.
The production of fish farms showed significant increases over the decade of the 90’s, growing from 3,000 tonnes in 1992 to an estimated 75,433.5 tonnes in 2006. Since then sector experienced a decline averaging approximately 5,800 tonnes. It is estimated that the industry is valued at approximate US$20 million annually.

4.3 Tilapia Market Structure
A study entitled Jamaica Tilapia Market Study commissioned by the Ministry of Agriculture, PSDP and Jamaica Trade and Invest (JTI) in 2008 segmented the tilapia market as follows.
1. Wholesalers/Retailers (62%)
2. Restaurants (19%)
3. Supermarkets (22%)
4. Hotels (6%)

4.4 Tilapia Demand
Demand for tilapia is greatest during the month of March and April, followed by August and finally December. It is estimated that demand increases by approximately 25%, 12% and 20% respectively.

5.0 POLICY RELATED TO AQUACULTURE
There is currently no policy document which outlines the development of aquaculture in Jamaica. The Ministry of Agriculture and Fisheries’ Agricultural Policy contains general policy goals that are applicable to aquaculture. The Fisheries Division of the Ministry of Agriculture and Fisheries has drafted policy and legislation which includes strategies for the further development of aquaculture in Jamaica. A brief synopsis of the policy and legislation is outlined below.

5.1 Fisheries Policy and Legislation
The government of Jamaica has drafted a fisheries policy and legislation which will address the needs of the Industry. The formulation of aquaculture development/management plans will be paramount tool used to guide the development of the aquaculture sub-sector. Fishers and fish farmers will be registered and licensed and the organization of aquaculture stakeholders will be encouraged. The policy also speaks to the zoning of lands for aquaculture in order to ensure orderly development of the aquaculture sub-sector.

In order to ensure that fish farms conform to best aquaculture practices, standards will be developed for the certification of fish farms, sanitary standards will also be developed in order to maintain and improve the food safety standards practiced in the harvesting and post harvest handling of aquaculture products. The international trade in fish and fish products also requires that hygiene standards throughout the value chain are regulated. The draft Fisheries Bill also contains legislation related to the control of the importation and introduction of live fish into Jamaica.

6.0 REGULATIONS GOVERNING THE AQUACULTURE SUB-SECTOR
Fishing Industry Act (1975)
The Fishing Industry Act of 1975 and the Regulations (1976) were established to govern the growth of the Fishing Industry in Jamaica. The Act does not make reference to Aquaculture. The Fisheries Division has drafted legislation to deal with the development and management of aquaculture in Jamaica.

6.1 Regulations that impact on Aquaculture
There are several other agencies that have regulations that govern the development of aquaculture. These regulations relate mainly to the use of resources such as water and land. The legislation fall under a number of agencies such as the National Environment and Planning Agency, the Water Resources Authority, the Veterinary Services Division and the Forestry Department to name a few. These regulatory agencies deal with issues such as:
1. Licenses and permits for the abstraction and use of water for the sinking or alteration of a well (The Water Resources Act, 1995)
2. Permits for the discharge trade effluent into open bodies of water (Natural Resources Conservation Authority Act, 1991). An Environmental Impact Assessment may be required prior to the establishment of an Aquaculture Facility, depending on the acreage of land that will be cleared.
3. Removal of endangered species such as crocodiles and some species of birds are protected under the Wildlife Protection Act.
4. The use of the seafloor. This is important when considering the establishment of mariculture facilities (The Beach Control Act (1956)).
5. The Importation and exportation of live fish in Jamaica. The Animal (Diseases and Importation) Act establishes procedures for the quarantine of imported and in the case of diseased animals quarantine, control and slaughter of animals in the event of an outbreak of a communicable disease.
6. The export of fishery products and by-products from Jamaica is controlled under the Aquaculture, Inland and Marine Products and By-products (Inspection, Licensing and Export) Act, 1999.

7.0 Existing Plans and Level of Implementation
Currently there is no defined plan related to aquaculture development in Jamaica. The policy related to aquaculture development is outlined in the Draft Fisheries Policy. The Fisheries Division provides extension, training and research services to the aquaculture sector. The Agriculture Policy contains general strategic objectives for the development of agriculture in Jamaica; some of these strategies are applicable to aquaculture development in Jamaica.

7.0 CHALLENGES AND CONSTRAINTS TO AQUACULTURE DEVELOPMENT
The Aquaculture industry has evolved significantly since its humble beginning in the 1940s; however several constraints have stymied the development of Aquaculture. These Include:

7.1 Marketing
- Competition from Imports - Tilapia from the Far East
- Imports of other species (usually cheaper than Tilapia) eg. Banga Mary
- Absence of Marketing strategy
- No established market structure. Currently, most farmers sell directly to retailers and as such they dictate the offering price.
- Consumer perception of Tilapia – taste is inferior to that of marine fish

7.2 Production
- High Input Cost
- Feed – 49% of stocking cost
- Electricity – 19% (stocking with fry),
  - 14% (stocking with fingerlings)
- Seedstock - 7% (stocking with fry), 24% (stocking with fingerlings)
- Labour – 23% (stocking with fry), 12% (stocking with fingerlings)

7.3 Praedial Larceny
High incidences of theft have and continue to negatively impact the profitability of framers.

8.4 Capital Investment cost
Average initial capital investment for a farmer is US$11, 900, very few farmers and by extension financial institutions are willing to invest in aquaculture based on the high incidence theft and ultimately failure.

8.0 CONCLUSION
Jamaica’s Aquaculture industry has centered on the production of Tilapia, shrimp and ornamental fish, since its commercialization in the 1970s; with tilapia being the major product. There has been little growth in the industry since 1997. Production from 1997 to 2009 remained between 4,000 MT
and 6,000 MT except in 2006 when production was 7,543 MT. Since then, the acreage in fish production and the number of farmers has declined significantly.

Despite the industry’s achievements, the need for a developmental plan for its continued existence and diversification of the industry is paramount. This plan must take into account the constraints of the industry, the financial environment and input costs.

It is envisaged that the Jamaican Aquaculture Industry will only achieved its full potential if a clearly charted road map is developed and implemented in short order.
SURINAME COUNTRY REPORT

General Information
Geography and Economy

<table>
<thead>
<tr>
<th>Location</th>
<th>North of South America, bordering North Atlantic Ocean, French Guiana, Guyana and Brazil</th>
</tr>
</thead>
</table>
| Area     | 163,820 sq. km  
  a. Land – 156,000 sq. km  
  b. Water – 7,820 sq. km |
| Length of coastline | 386 km |
| Shelf area (to 200 nm) | 54,550 sq. km |
| Terrain | Varies from coastal swamps and tropical rainforest to savanna and hills |
| Climate | Tropical |
| Temperature | 28°C (Average) |
| Population (2010) | 486,618 |
| Annual growth rate (2010) | 1.108% |
| Languages | Dutch (official), English, Sranan Tongo (lingua franca) |
| Labor force | 165,600 |
| Unemployment rate (2004) | 9.5% |
| GDP (2010) | SRD 15,758.4 billion (US$4.704 billion) |
| GDP growth rate (2010) | 3.5% |
| GDP per capita (2010) | SRD 33,165 (US$ 9,900) |
| Currency unit (2010) | SRD 3.35 = US$1 |
| Agriculture | 8% of GDP (2010). Products: rice, bananas, timber, shrimp & fish, and fruits |
| Export products | Rice, timber, shrimp, fish, fruits, gold, flowers, bauxite, aluminum, crude oil |

The capital is Paramaribo. About 50% of the population lives in Paramaribo. Another 100,000 in semi-urban areas close to the capital. About 15% live in the southern Interior Rainforest, which accounts for 80% of the country’s total area.

History
By the end of the 1800’s some of the abandoned cotton plantations were used for a form of fish farming. At high tide the sluices were opened to let brood stock in. After that the sluices were closed and the fish were farmed with no further interventions. These plantations were rented from the governor by fish farmers for extensive aquaculture.

In 1949 there was an attempt to farm *Mugil spp.* (Kweriman) on one of these farms but it was not successful. In 1955 the method of farming was changed which lead to increased production, although a lot of problems remained. One of which was the irregular supply of brood stock. Another problem was a large amount of algae in ponds that were not in production. In light of this another species who would comply with the following requirements was sought:

- A herbivore which could feed on algae
- A production of brood throughout the year
- Ability to survive between the predatory species in ponds
- Survive in saltwater as well as freshwater
- Suitable for human consumption
Unfortunately none of the indigenous species complied with all the requirements and in 1955 three pairs of tilapia (*Oreochromis mossambicus*) were imported from Trinidad. The brood of this tilapia and some other coastal fish species were introduced in the ponds. These experiments (1957) were a success and paved the way for further exploitation of this species. In 1958 the amount of ponds was increased. The quality of the tilapia was accepted by the population (Lijding, 1958).

From 1956 to 1958 tilapias were released in the wild, the result was that within a few years these coastal swamps, lagoons and inland waterways had large populations of tilapia.

Other sources were less enthusiastic about tilapia farming. The forming of deposits in ponds and canals was one of the large problems. The fish was also not accepted by the population as was previously assumed (Kuiper 1974).

In 1965 the Japanese fish biologist, Mr. Yamashita, researched the possibilities of brackish water aquaculture in the Matapica area. The possibilities for oyster and shrimp farming were also researched. Experiments with the Mugil spp. were repeated, but the mayor problems were that predatory fish could not be kept out of the ponds as well as sludge deposits in the ponds. Yamashita concluded that the Matapica area had potential for brackish water aquaculture and proposed to place a sludge catcher between the canals and ponds to resolve the problem of sludge deposits. In 1970 Chinese grass carp was imported by Mr. Yamashita for cultivation and export to the Caribbean but this project was a failure.

In 1971 a plan for an aquaculture station was formulated, but was rejected. In 1974 the possibility for fresh water aquaculture was researched in the Saramacca district. The species used were native swamp (*H.litorale*) - and catfish such as channel- catfish (*Ictalurus punctatus*) from the United States. The results of this experiment were satisfactory.

In 1980 a literature study was done for the possibilities for cultivation of *Macrobrachium rosenbergii*. Several native species of Macrobrachium (*M.surinamicum, M.amazonicum and M.carcinus*) were also researched. The first results in 1985 were promising while the native species gave less satisfactory results.

In 1986 the possibility for the cultivation of kwie-kwie (*Hoplosterium littorale*) was also performed. Surland N.V. entered into a joint-venture with a Chinese counterpart for the production of shrimp larvae. This project was done in Tawajari. Study on the production of larvae of *M.rosenbergii* and *H. litorale* was also done in laboratory conditions at Jarikaba-4 (Power,1990).

The Anton de Kom University of Suriname and the Cellos Institute also did research (1982) on the biology and ecology of (*H.litorale*).

In Matapica experiments on the cultivation of sea turtles (*Chelonia mydas*) were also done (not published Berenstein 1984).

In the eighties a feasibility study on the possibilities of cultivating brackish water shrimp in the Commewijne district was done. The outcome of this study resulted in commercial cultivation of *P.vannamei*. Since then various attempts and studies have been done on the possibilities for aquaculture. The two species actually cultivated are the *Litopenaeus vannamei* and the red tilapia.

In the 90’s there were several aquaculture farms which cultivated mainly red tilapia and *P. vannamei*. For over 10 years Suriname farmers went through a learning process with all the trials and tribulations that such a process involved. The culture of shrimp (*L.vannamei*) and Tilapia (Red hybrid and
Oreochromis mossambicus) in Suriname started gradually. There are some factors that have contributed to this success, these are:

- Treatment of pond bottom between two crops.
- Use of nursery tanks for post-larvae reception and acclimatizing.
- Use of fixed feeding trays.
- Use of aeration.
- Use of disease free strain.

**Importance of Aquaculture**

The worldwide catches of fish are not expected to grow anymore and in the recent years have started to decline and will not be able to satisfy the demand for fish and fisheries products. In the near future there will be a shortage of these products and this shortage could be supplemented by aquaculture production.

Development of aquaculture in Suriname is obvious for the following reasons. Studies have shown that the climate, as well as the physical-chemical condition of soil is favorable for aquaculture. Another reason is that water reserves (brackish and freshwater) are abundant.

Development of this sector can also give a great impulse to the Surinamese economy.

**Description**

In Suriname the main type of aquaculture is the cultivation in ponds.

**Shrimp cultivation**

In Suriname the shrimp ponds are stocked with larvae imported from the United States (SPF free facilities). The larvae arrive in plastic bags with a density of 1500 per liter. The larvae are acclimatized for a couple of days and are there after stocked into the ponds. The process ends over a five month period of cultivation. In this period the shrimp are fed with a high protein feed. The shrimp are harvested at weights between 18 and 20 grams. After harvesting the shrimp are deheaded for marketing.

**Tilapia cultivation**

The first step in the cultivation of tilapia is to produce larvae. The second step is to nurse these larvae into fingerlings, and the third step is to stock these fingerlings into ponds. The production of the larvae takes place in the spawning ponds where males and female tilapia are kept together. After the spawning has occurred the parents are moved from these ponds and the fish larvae are treated with methyltestosterone to transform the population into males. Males become bigger, and there won’t be reproduction in the cultivation period. After these the fry’s are moved to nursery ponds where they grow into fingerlings. The fingerlings are stocked in grow-out ponds at a density of 5-10 fingerlings per m². After a period of almost a year the fish can be harvested at a size between 500-750 grams.

**Current situation**

In Suriname the aquaculture is mainly focused on the cultivation of tilapia, shrimp and native swamp fish. In recent years however some individuals have expressed their interest in cultivating ornamental fish.
Some aquaculture production statistics over the last ten years are:

<table>
<thead>
<tr>
<th>Export of Cultivated Shrimp</th>
<th>Net. Weight (tonne)</th>
<th>Value (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>95.1</td>
<td>913,008.74</td>
</tr>
<tr>
<td>2001</td>
<td>219.1</td>
<td>1,697,975.59</td>
</tr>
<tr>
<td>2002</td>
<td>143.4</td>
<td>248,108.50</td>
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<tr>
<td>2003</td>
<td>211.3</td>
<td>785,147.52</td>
</tr>
<tr>
<td>2004</td>
<td>171.3</td>
<td>533,042.70</td>
</tr>
<tr>
<td>2005</td>
<td>108.3</td>
<td>225,161.40</td>
</tr>
<tr>
<td>2006</td>
<td>101.5</td>
<td>231,175.00</td>
</tr>
<tr>
<td>2007</td>
<td>19.2</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>0.1</td>
<td></td>
</tr>
</tbody>
</table>

In the last years there have been no exports of aquaculture products. At the moment there is only one commercial aquaculture farm in production, Comfish N.V. located in the Commewijne district. Their production is currently destined for the local market and they have been Global GAP certified in the 2010.

**Laws/Regulations**
The concept Aquaculture legislation is in the process of approval.

**Existing plans**
**Aquaculture station at Oryza**
Currently there are plans for the construction of an aquaculture station to enable farmers to buy their brood stock and, if needed, they can receive training and guidance in their venture. The preliminary tests for water quality and location have been done and the results were satisfactory. This project is being co-financed by the FAO and has been approved for technical assistance by a FAO consultant. The location for this aquaculture station cannot be used at the moment and is actually on hold.

**Rice-fish project in Nickerie**
This FAO project started in 2004 as an experiment of simultaneously cultivating *H. litorale* and rice. The results were satisfactory and the project is now in the second phase. Some ponds need to be revised but cannot be repaired at the moment due to the fact that the rice fields are in production moment. This project is on hold till the harvest season.

**Disease Monitoring Plan for Aquatic Animals**
This is a project for monitoring the existence and prevalence of various diseases that can affect aquatic animals (including aquaculture species) that will be co-financed by the FAO. The Terms of Reference is currently at the FAO awaiting approval for funds for technical assistance.

**Lessons Learned**
**Expertise**
The expertise necessary for aquaculture is lacking for the most part in Suriname. The information that is available is outdated and expertise is usually imported, which makes it necessary to attract foreign consultants.

**Marketing**
In the past marketing was done mainly as an afterthought which led to many companies to produce aquaculture products with no market. This led to high losses and eventually bankruptcy for many of them. The necessity for certification of aquaculture establishments is also important for improvement of their position on the world market.
Inputs
Many of the aquaculture inputs need to be imported, which translates into higher production costs and decreased competitiveness.

Challenges and Constraints
The main challenges and constraints which the aquaculture sector faces are the following:

1. Lack of knowledge which can be classified as the most important problem. This Knowledge concerns the following aspects:
   a. Cultivation
      Insufficient knowledge (and expertise) in most cases leads to hybrids (not the correct aspect regarding; shape, color, taste). Even expert cultivators get serious problems when the desired product is not obtained. In the case of cultivation of ornamental fish, there is very little information on the breeding of the species of interest.
   b. Agricultural Engineering
      Insufficient know-how results in inadequate design of infrastructure (construction of ponds, water supply channels, etc.).
   c. Marketing
      The entrepreneurs must be well informed on the demands of the market, in order to avoid marketing failure, because without sales there is no need for production. Unfortunately underestimation of marketing is encountered. Marketing of the product is often seen as an afterthought. The required know-how is in most cases “imported” for a relatively high price by aquaculture entrepreneurs.

2. Lack of Expertise
   Experience in other parts of the world has shown that a lack of expertise and qualified personnel is one of the main reasons for the failure of aquaculture projects. Personnel is needed on every level (University, mid-level and lower staff) of different disciplines. The management of small and large enterprises is very important and therefore training should be available.

3. Financial constraint
   Aquaculture companies take huge loans for setting up as well as part of the exploitation costs. These companies have to pay high interest rates at the bank due to the high risk factor that the banks ascribe to these ventures. Since aquaculture needs large sums of money and does not constitute stable development it is clear that most entrepreneurs and small farmers because of the high interest rates cannot use these credit facilities.

4. Insufficient means of export
   Entrepreneurs observed limitations in export, no reliable flight connections, high freight cost and insufficient freight capacity.

5. Insufficient cooling and storage facilities
   Species that are being exported require adequate cooling and storage facilities. On the airport and port the facilities as well as the area to construct these are absent. In case of sea freight there is access to a storage facility and some ships have containers with built-in chillers.

6. Insufficient government support;
   The government does not give financial nor institutional help to entrepreneurs and small farmers in the sector. The cumbersome procedures for the application of licenses (for starting up a venture as well as for export and import) are de-motivating and seriously delay the planning of entrepreneurs. Complicated procedural aspects around the imports can be disastrous for the import of sensitive inputs such as brood stock.
7. Lack of necessary inputs
Suitable inputs such as parental brood stock, fry, feed, nets, etc. are not available on the local market. The available inputs are of inferior quality and are expensive, which necessitates import of the inputs needed.

8. Outdated investment legislation
There is need of an investment code, which attracts local and foreign investors.

9. Lack of legislation
At the moment legislation for aquaculture is in the process of approval.

10. Insufficient availability of information
The information available at the ministry and in libraries is often lacking and/or outdated.
Introduction
The history of Aquaculture in Trinidad and Tobago spans a period exceeding 60 years. The Java Tilapia (*Oreochromis mossambicus*) was introduced to Bamboo Grove Research and Development Station during the 1950s. Previous attempts to cultivate rainbow trout (*Oncorhynchus mykiss*) and common carp (*Cyprinus carpio*) (in 1934 and then in 1947, respectively) were not successful. Red hybrid Tilapia was introduced from Jamaica in 1983 and super male technology was introduced in 2006.

Most attempts at aquaculture development in Trinidad and Tobago have not been successful, primarily due to improper planning, poor vision or scope in the approach to commercial aquaculture, and inadequate or inconsistent management practices. The most notable attempt which approached commercial viability was established by Caroni (1975) Limited (the former Sugar Cane Company), in 1989. The pilot phase consisted of a multipurpose hatchery and 9.5 ha (25 acres) of earthen ponds for grow-out operations. The project produced Malaysian prawns (*Macrobrachium rosenbergii*), cascadura (*Hoplosternum littorale*) and red hybrid tilapia. Production eventually focused on tilapia. Economies of scale were not met and significant profits were not generated. The project was discontinued in 2000.

Current Situation
The Fisheries Division of the Ministry of Food Production, Land and Marine Affairs, has the mandate to manage Fisheries and Aquaculture in Trinidad. The Department of Marine Resources and Fisheries of the Tobago House of Assembly has the similar mandate for Tobago, with a jurisdiction extending to six (6) nautical miles.

The Fisheries Division is headed by the Director of Fisheries. Technical work is supervised by a deputy director called the Senior Fisheries Officer. There is support from administrative and technical staff. The Division is comprised of four (4) functional units: Administration, Extension, Aquaculture and Research.

Other State Agencies which are involved in aquaculture include:
The Institute of Marine Affairs (IMA), Chaguaramas; The University of the West Indies (UWI), St Augustine Campus; The Sugar Cane Feed Centre (SFC), Longdenville; and The Seafood Industry Development Company (SIDC), Charleville.

The major functions of the Fisheries Division’s Aquaculture Unit, includes:
- Extension and training geared toward farmers in areas of earthen pond and tank based aquaculture.
- Dissemination of biotechnical information on aquaculture and aquaculture species.
- Conduct of training in commercial aquaculture.
- Administration of ornamental fish trade.
- Development and testing (where possible) of models for commercial intensive aquaculture.

Trinidad and Tobago has traditionally relied on catches from the marine environment to satisfy its fresh fish demands. However, within the last decade, prices have increased (due primarily to increased demand for fish and decreasing catches) so that prices for fish from aquaculture production are now comparable to less preferred marine species.
With a resurgence of interest in Aquaculture in Trinidad and Tobago partly due to national and global trends, favourable economic climate, increased consumer acceptance of tilapia and increase in fish prices from marine landings, there has been an increase in requests for technical information and assistance. However, a paradigm shift in the traditional approaches and general thinking about aquaculture is required for the sector to be successful.

With an emphasis on addressing some of these issues, several models for tank based aquaculture have been developed and are being field tested to provide demonstration facilities and statistical data to guide potential investors, farmers and financial institutions. Underpinning this strategy is commitment on the part of the Division and collaboration with key stakeholders in the sector. The aim is to foster a better informed, organised and coordinated approach to commercial aquaculture.

Presently the emphasis is on tilapia since it is relatively easy to cultivate and suited for the majority of inexperienced aquaculturists. Four (4) systems have been developed. Two (2) have been implemented and field testing is underway. Two other systems are awaiting field testing.

i. A tank based pilot version of a large scale intensive commercial clear water re-circulating tilapia culture system comprised of 12 circular fibreglass tanks (20’ in diameter and 4’ in height) was set up at IMA in Chaguaramas. Some harvesting and marketing have already been done but a complete evaluation is yet to be prepared. The project was done in conjunction with IMA and financed by SIDC. (Photos 1 & 2).

ii. A tank-based pilot version of a large scale commercial green water tilapia culture system comprised of six (6) circular fibreglass tanks (20’ in diameter and 4’ in height) has been set up at SIDC in Charlieville. This project was financed by SIDC. Some harvesting and marketing has already been done. (Photos 3 & 4).

iii. A small scale intensive commercial green water re-circulating tilapia system comprised of 16 plastic circular tanks (5½” in diameter and 4’in height) has been developed by Fisheries Division. Implementation for field testing is underway. (Figures 1, 2 & 3).

iv. A medium scale intensive commercial green water re-circulating tilapia culture system comprised of eight (8) plastic circular tanks (10’ in diameter and 4’ in height) has also been developed by Fisheries Division. This system is awaiting field testing. (Figures 4, 5 & 6).

### Production Statistics—Food Fish (2010)

<table>
<thead>
<tr>
<th>Producer</th>
<th>Lbs</th>
<th>Kgs</th>
<th>TT$/Lb</th>
<th>USD/Lb</th>
<th>TT Earnings</th>
<th>US $ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMA</td>
<td>12775</td>
<td>5809</td>
<td>8</td>
<td>1.25</td>
<td>102200</td>
<td>15968</td>
</tr>
<tr>
<td>SIDC</td>
<td>3688</td>
<td>1676</td>
<td>8</td>
<td>1.25</td>
<td>29504</td>
<td>4610</td>
</tr>
<tr>
<td>Private Farmers</td>
<td>5000</td>
<td>2272</td>
<td>10</td>
<td>1.57</td>
<td>50000</td>
<td>7850</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>21463</strong></td>
<td><strong>12021</strong></td>
<td><strong>--------</strong></td>
<td><strong>--------</strong></td>
<td><strong>181704</strong></td>
<td><strong>36278</strong></td>
</tr>
</tbody>
</table>

### Ornamental Fish (2010)

The Division’s Aquaculture Unit is responsible for recommending the import and export of ornamental fish to the Ministry of Trade and Industry. This exercise also involves inspections of fish to be traded at the Piarco International Airport. For 2010- five hundred and four (504) such inspections were conducted. Seventy-seven (77) fish import applications were processed, amounting to 181,138 fishes valued at TTD464,021.67. Five hundred and twenty-nine (529) export applications were processed, amounting to 6,186,985 fishes valued at TTD1,202,437.41. Most imports were from the USA and South America of species from around the world. Exports were to the USA and CARICOM.
### Ornamental Fishes (2010)

<table>
<thead>
<tr>
<th>Airport Inspections</th>
<th>Trade</th>
<th>Applications Processed</th>
<th>No. of fishes</th>
<th>TT$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>77 Import</td>
<td>77</td>
<td></td>
<td>181,138</td>
<td>464,021.67</td>
</tr>
<tr>
<td>529 Export</td>
<td></td>
<td></td>
<td>6,186,985</td>
<td>1,202,437.41</td>
</tr>
</tbody>
</table>

**Funding**
For the current fiscal year, October 2010 to September 2011, the Aquaculture unit received TTD 300,000.00 (USD 47,000.00) for use in the following areas:

- i. Aquaculture Planning and Administration
- ii. Training and Extension support
- iii. Institutional strengthening
- iv. Development of New Culture Systems

There are no donor funded projects.

**Challenges and Constraints**
The Fisheries Division is in the process of acquiring physical facilities to establish aquaculture training, testing and demonstration facilities. In the interim, the Division has to rely on other agencies to implement and test models and systems it has developed. Aquaculture is considered to be a subset of the fisheries sector and as such there are no established incentives and subsidies for aquaculture. Established and potential aquaculturists are clamouring for market support since production is sporadic and markets are not developed.

The following have been identified as the major impediments to mobilising the sector so that its full potential to contribute to food security in Trinidad and Tobago can be realised:

- Testing, training and demonstration infrastructure.
- Provision of incentives.
- Market intelligence.
Photo 1: Shade house structure for clear water system at IMA

Photo 2: Clear water system at IMA
Photo 3: Green water system at SIDC

Photo 4: Growing tank and clarifier at SIDC
Figure 1 Showing layout of small scale system.
S1, S2, S3,– Sedimentation tanks
D1, D2, – De-gassing tanks
N1, N2- Nursery tanks
Sump from where the submersible pump will return filtered water to grow out tanks.
Figure 2 Showing side view of grow out tanks

Figure 3 showing side view of filtration system S1, S2, S3. Sedimentation tanks. D1 & D2 De-gassing tanks. N1, N2 Nursery tanks. Sump from where the submersible pump will return filtered water to grow out tanks.

Figure 1 Showing layout of system S1, S2, S3 Sedimentation tanks. D1, D2, D3 De-gassing tanks. X Submersible pump.
Figure 5 Showing side view of grow out tanks

Figure 6 Showing side view of filtration system for medium scale system
S1, S2, S3 - Sedimentation tanks.
D1, D2 - De-gassing tanks
Appendix IV: Project Cycle Management

PCM

*Project Cycle Management*

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Orientation:

**Goals of this session**

1. To be familiar with the PCM method
2. To understand the Logic of ‘Logical Framework’ ‘PDM’
3. To discuss and analyze the issues and problems related to your action plan

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Definition of Project Cycle Management

To manage the cycle of Development Project – Plan, Implementation, Evaluation – by using Project Design Matrix (PDM)

Project Cycle

Evaluation

See

Plan

Planning

Project Design Matrix

Do

Implementation / Monitoring

Common Format

PDM

Action
PCM Workshop

Participation

① Reflection of social necessity
② Fair opportunity
③ Consensus among all the participants

Planning Process

① Problem Analysis
② Objective Analysis
③ Alternatives Analysis (Project Selection)
④ Formulation of PDM
## Project Design Matrix (PDM)

<table>
<thead>
<tr>
<th>Narrative Summary</th>
<th>Objectively Verifiable Indicators</th>
<th>Means of Verification</th>
<th>Important Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Goal :</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Purpose :</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outputs :</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activities :</td>
<td>Inputs</td>
<td></td>
<td>Pre-Conditions</td>
</tr>
</tbody>
</table>

## Characteristics & Benefits of introducing PCM

### Characteristics
- **Consistency**: Standardized matrix
- **Logical**: Tree-form chart

### Participation
- **Consensus**

### Transparency
- **Recorded charts/matrix**
Problems Analysis

Analytical Stage 1

Why Problem Analysis?

To solve problems, we have to know the problems better.

Problems Analysis is one of the methods.
What is Problem Analysis?

Analyzing problems by finding out the causes and effects.

How can we start Analyzing Problems?

Problem A  Problem B  Problem C
Problem D  Problem E
Problem F  Problem G

Core Problem
Rule of card writing

(1) Write only existing problems.

(2) Write one problem on one card.

(3) Write in a sentence.

(4) Avoid writing “There is no~”.

Problems Analysis
Problems Analysis

<Problems Tree>: Example

Fisher’s children cannot go to school.  
Fisher’s family live under poor health condition.

Fisher’s income is low.

Effect

Cause

The amount of fish catch is small.

Fish prices is too low for paying fishing costs.

Core Problem
Objectives Analysis
Analytical Stage 2

Why Objectives Analysis?
To solve problems, we have to set up objectives to be achieved.

Objectives Analysis is one of the methods.
What is Objectives Analysis?

Analyzing objectives by finding out the means and ends based on the problems analysis.

Objectives Analysis

<Objectives Tree>
- Ends
- Means

Core Objective

Write “Situation”

Practicability
Objectives Analysis

Fisher’s children can go to school.
Fisher’s family live under good health condition.

Fisher’s income is improved.

The amount of fish catch is increased.
Fish prices is appropriate for paying fishing costs.
Project Selection & PDM

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Project Selection

<Objectives>
To draw up the project blueprint based on the previous analysis, budget, and personnel.

~Process of selecting the appropriate project~
Identify the approaches (candidates for project) in the Objectives Tree, compare those approaches, and select one or some approaches as a project
Process of Alternative Analysis

1. Confirming possible constraints (e.g. budget, duration)
2. Identifying the approach in the Objectives Tree.
3. Naming each approaches
4. Comparing the approaches based on the set-up criteria.
5. Selecting one or several approaches as the project

Alternatives Analysis (Project Selection)

Identification of Approaches

- Priority
- Inputs
- Technical Aspects
- Target Group
- Social factors
- Environmental Aspects
- Financial / Economical Aspects
- Achievements
- Others
Project Selection

<Approach Comparison (Eg.)>

<table>
<thead>
<tr>
<th>Effects on Core Objective</th>
<th>Cost</th>
<th>Feasibility</th>
<th>Emergency</th>
</tr>
</thead>
<tbody>
<tr>
<td>“×△ Approach”</td>
<td>4</td>
<td>Low</td>
<td>2</td>
</tr>
<tr>
<td>“○△ Approach”</td>
<td>2</td>
<td>Low</td>
<td>3</td>
</tr>
<tr>
<td>“△△ Approach”</td>
<td>2</td>
<td>High</td>
<td>1</td>
</tr>
<tr>
<td>“×○ Approach”</td>
<td>3</td>
<td>High</td>
<td>4</td>
</tr>
<tr>
<td>“×× Approach”</td>
<td>2</td>
<td>Low</td>
<td>2</td>
</tr>
</tbody>
</table>

*1 to 4 scale Evaluation (except Cost)

How can we plan a project based on the selected approach?

Selected Approach

PDM
Project Design Matrix (PDM)

**<Positioning of PDM>**
1. To be the master plan of the project.
2. To be used as a basic tool of project management on all front.

**<Objectives>**
1. To design the project with clear image.
2. To express the project by using the common format for anyone to understand.

---

**Structure of Project Design Matrix (PDM)**

<table>
<thead>
<tr>
<th>Project Title:</th>
<th>Target Group:</th>
<th>Version:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Area:</td>
<td>Duration:</td>
<td>Date:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Narrative Summary</th>
<th>Objectively Verifiable Indicators</th>
<th>Means of Verification</th>
<th>Important Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Goal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Purpose</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outputs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activities</td>
<td>Inputs</td>
<td></td>
<td>Pre-Conditions</td>
</tr>
</tbody>
</table>

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Narrative Summary

**Overall Goal**
- A long term objective to be attained by the realization of the Project Purpose.

**Project Purpose**
- An objective to be realized by the end of the project period.

**Outputs**
- Sub-objectives need to be achieved to realize the Project Purpose.

**Activities**
- Tasks to be undertaken to achieve the Outputs.

Do you see “Means – End” Relation?

How can we reflect the result of objectives analysis?
Important Assumptions and Pre-Conditions

**Important Assumptions**
- Factors (uncertain, external, and important) which are necessary to be satisfied to realize the upper level of goal.
- Conditions to sustain the development effect.

**Pre-Conditions**
- Conditions that are necessary to be satisfied before starting the project.

---

**Reading PDM**

<table>
<thead>
<tr>
<th>Narrative Summary</th>
<th>Objectively Verifiable Indicators</th>
<th>Means of Verification</th>
<th>Important Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Goal :</td>
<td></td>
<td></td>
<td>Vertical Logical Relationship</td>
</tr>
<tr>
<td>Project Purpose :</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outputs :</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activities :</td>
<td>Inputs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

*IC Net Limited*
Objectively Verifiable Indicators

<table>
<thead>
<tr>
<th>What?</th>
<th>Measuring figures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Of whom?</td>
<td>Target group</td>
</tr>
<tr>
<td>Of where?</td>
<td>Target area</td>
</tr>
<tr>
<td>How much?</td>
<td>Quantitative goal</td>
</tr>
<tr>
<td>How well?</td>
<td>Qualitative goal</td>
</tr>
<tr>
<td>By when?</td>
<td>Schedule</td>
</tr>
</tbody>
</table>

Means of Verification

- Reliable data source.
- Sustainable data source.
- If not available, include “data collection” in Activities.
- Beware of data collection costs.

An Example of Objectively Verifiable Indicator and Means of Verification

**Objectively Verifiable Indicator:**

By October 2005, fish catch of XX village increases 5% from the current level.

**Means of Verification:**

Fish landing data in Y district office
Inputs

Needed to start/complete the Activities.

- Personnel -
- Equipment -
- Materials -
- Facilities -
- Operational Costs -

Project Design Matrix  PDM

<table>
<thead>
<tr>
<th>Narrative Summary</th>
<th>Objectively Verifiable Indicators</th>
<th>Means of Verification</th>
<th>Important Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Goal :</td>
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<td></td>
<td></td>
</tr>
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<td>Project Purpose :</td>
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<td></td>
</tr>
<tr>
<td>Outputs :</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activities :</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Inputs

- Personnel (Indonesian, Japanese)
- Facilities and equipment
- Budget (Indonesian, Japanese)
- Training in Japan
- Other necessary inputs

Pre-Conditions

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Appendix V: Problem Analysis
Jamaica
Problem Analysis

Core Problem
Absence of a ratified aquaculture policy and development plan

Extension support is weak
Farmers cannot access local milk competitively

Inability to access export market
Poor communication with policy makers
Inadequate low level fish production

Inadequate extension capacity
Lack of knowledge of market size/demand

Inadequate local distribution
Competition of cheap imports (SE Asia)
Fish price is too high
Lack of institution collaboration
Poor feed quality
Low level of fingerling production
Lack of access to suitable aqua lands
Poor drainage infrastructure in major aqua site

Inadequate supply of quality feed stocks of the right size

Low demand for tilapia
High feed, energy and labor cost
High cost of capital
High security cost
Needs for seed stock production diversification

Inadequate industry relate R & D

Lack of acceptance for taste of tilapia
Inadequate financial support
High level of paternal laxancy

High demands for collateral from farmers
Inadequate credit facilities for farmers
Inadequate technical capacity on farmers
Need to improve aqua curriculm in training institution
Inadequate budgetary support
Suriname
Problem Analysis

Core Problem: Aquaculture development is very slow in Suriname

- High exploitation cost
- Aquaculture is not properly defined
- Lack of land zoning plan
- Insufficient management skills (large scale aqua)
- Lack of skilled workers (small scale aqua)
- Cultured species is not generally accepted locally

- Feed price is too high
- Farms rely on expensive diesel pumps
- Freight costs for export is high (High freight cost for small capacity)
- Inadequate fisheries law in which aquaculture is incorporated
- Lack of research on locally available species that could be cultured
- Mechanism for land acquisition is not transparent
- Lack of awareness programme for aquaculture development

- Energy availability is not everywhere and expensive
- It is difficult to get loans for aquaculture purposes
- Lack of awareness programme for aquaculture development
- Inadequate incorporation of aquaculture in the national agriculture plan

- Locally produced feed is of inferior quality and not certified
- High failure rate of aquaculture ventures (large scale) in the past
- Insufficient feasibility study when starting up
- There is inadequate training facilities
- Insufficient research in usage of local raw materials in feed production

- Raw materials for feed needs to be imported
- Aquaculture draft law in process of adaption
- Information available is outdated

77
Appendix VI: Objective Analysis
Jamaica Objective Analysis

Core Objective
- Increased local consumption of locally produced tilapia

Production Approach
- Increase R&D activity
- Develop human resources of aqua sector through training
- Ensure adequate budgetary support

Policy Approach
- Increase the capacity of farmers' grouping
- Strengthen the capacity of farmers' collaboration for aquaculture planning/ development

Marketing Approach
- Increase integrated institutional collaboration for aquaculture
- Improve communication with policy makers and stakeholders

Extension Approach
- Increase/improve promotion of tilapia
- Reduce security costs
- Introduce ecosystem based approach to aquaculture

Increased access to ECO labeled export market niche
- Conduct a comprehensive market analysis and promotion study
- Improve price competitiveness of fish

Ensure adequate budgeting support
- Develop marketing/retail outlets for tilapia/aquatic product
- Lower the cost of production

Strengthen the capacity of extension service
- Improve extension capacity

Aquaculture production levels increases
- Reaffirm aqua policy
- Increase access to suitable aqua lands
- Increase supply of quality seed stock
- Improve current infrastructure and its availability
- Reorganization or organization of project model

Implement practical incense prevention/mitigation strategy
- Alternative aquaculture species
- Alternative feed/quality

Improve communication with policy makers and stakeholders
- Improved seed for transport
- Diversity seed stock production

Political will
- Increase access to suitable aqua lands
- Increase supply of quality seed stock
- Improve current infrastructure and its availability
- Reorganization or organization of project model

Implement practical incense prevention/mitigation strategy
- Alternative aquaculture species
- Alternative feed/quality
## Appendix VII: Project Design Matrix

<table>
<thead>
<tr>
<th>Country: Belize</th>
<th>Project Title: National Aquaculture Revitalization</th>
<th>Target Group: Aquaculture Producers and Lending Institutions</th>
<th>Project Period: 18 months</th>
<th>Target Area: Marine, Coastal &amp; Inland Aquaculture Areas</th>
</tr>
</thead>
</table>

### Overall Goal

To expand the aquaculture industry on a sustainable basis.

- 1. Increase contribution of aquaculture to GDP
- 2.

### Project Purpose

- Increase prospects for success of commercial aquaculture operations.
- 1. Decrease feed cost and default rate on bank loans
- 2.

### Outputs

1. Improveduling of aquaculture operations.

- 1.1 Decrease stink damage to fish
- 1.2 Decrease stink damage to shrimp

2. Improved screening of loan applications by banking institutions.

- 2.1 Improvement in performance of loan review processes associated with aquaculture
- 2.2 Testing staff received basic technical and economic aspects of aquaculture

3. Decreased production costs.

- 3.1 Increase productivity of aquaculture operations
- 3.2 Increase in disposable income available to farmers

### Activities

1.1 Enact legislation with site selection

- 1.1 Evaluate Aquaculture Site

- 1.1.1 Organize site visit by Aquaculture Site Evaluation Team

- 1.1.2 Evaluate the feasibility of the site for aquaculture production

- 1.2.1 Conduct training for bank officers on technical aspects of aquaculture

- 1.3.1 Develop and implant new local platforms for shrimp farming

- 1.3.2 Develop and implant new local platforms for fish farming

- 1.4.1 Conduct training for bank officers on financial aspects of aquaculture

- 1.5.1 Conduct training for bank officers on management aspects of aquaculture

- 1.6.1 Develop and implant new local platforms for shrimp farming

- 1.7.1 Conduct training for bank officers on operational aspects of aquaculture

- 1.8.1 Conduct training for bank officers on operational aspects of aquaculture

- 1.9.1 Conduct training for bank officers on operational aspects of aquaculture

- 1.10.1 Conduct training for bank officers on operational aspects of aquaculture

### Inputs

- Personnel:
  - Act 1.2.1 Senior Aquaculture Officer
  - Act 1.2.2 Aquaculture Officer
  - Act 1.2.3 Aquaculture Officer

- Equipment & Materials:
  - Act 1.3.1 Computer
  - Act 1.3.2 Computer

- Facilities:
  - Act 1.4.1 Office Space & Transportation
  - Act 1.4.2 Office Space & Transportation

- Operational Cost:
  - Act 1.7.1 Operational Cost
  - Act 1.7.2 Operational Cost

- Others:
  - Act 1.8.1 Operational Cost

### Narrative Summary

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Enact legislation with site selection</td>
</tr>
<tr>
<td>1.2</td>
<td>Evaluate Aquaculture Site</td>
</tr>
<tr>
<td>1.3</td>
<td>Develop and implant new local platforms for shrimp farming</td>
</tr>
<tr>
<td>1.4</td>
<td>Conduct training for bank officers on financial aspects of aquaculture</td>
</tr>
<tr>
<td>1.5</td>
<td>Conduct training for bank officers on management aspects of aquaculture</td>
</tr>
<tr>
<td>1.6</td>
<td>Develop and implant new local platforms for fish farming</td>
</tr>
<tr>
<td>1.7</td>
<td>Conduct training for bank officers on operational aspects of aquaculture</td>
</tr>
<tr>
<td>1.8</td>
<td>Conduct training for bank officers on operational aspects of aquaculture</td>
</tr>
<tr>
<td>1.9</td>
<td>Conduct training for bank officers on operational aspects of aquaculture</td>
</tr>
<tr>
<td>1.10</td>
<td>Conduct training for bank officers on operational aspects of aquaculture</td>
</tr>
<tr>
<td>Activities</td>
<td>Inputs</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1.1 Undertake a survey to determine fish capacity requirements.</td>
<td>3.2 Conduct an economic analysis of the sector and its potential for growth.</td>
</tr>
<tr>
<td>1.2 Design and deliver training program.</td>
<td>4.4 Provide for the capacity to train personnel in the sector.</td>
</tr>
<tr>
<td>1.3 Undertake a survey to determine the number of trained personnel</td>
<td>5.1 Monitor and evaluate the impact of training on fish production and overall development.</td>
</tr>
<tr>
<td>1.4 Assess the feasibility of the development of new technologies and</td>
<td>6.0</td>
</tr>
<tr>
<td>1.5 Design and deliver training program with professionals providing</td>
<td>7.7</td>
</tr>
<tr>
<td>1.6 Provide access to new technologies and new methods.</td>
<td>8.0</td>
</tr>
<tr>
<td>1.8</td>
<td>10.0</td>
</tr>
</tbody>
</table>
## Narrative Summary

<table>
<thead>
<tr>
<th>Overall Goal</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase significantly the fish farmer productivity</td>
<td>1</td>
</tr>
<tr>
<td>Increased production at a significant level</td>
<td>2</td>
</tr>
</tbody>
</table>

## Project Purpose

### Outputs

| 1. Feed stock is available at affordable price | 1.1: Farmers can buy feed and fish are fed at 7% of their body weight |
|                                              | 1.2: More farmers engaged in fish farming |
| 2. Fish quality is increased                | 2.1: Growth increase significantly |
| 3. Aquaculture Equipments are available     | 2.2: Better quality of feed, Domains increase and consumption |
|                                             | 3.1: Construction of new facilities - more ponds created |
|                                             | 3.2: Good Aquaculture project are carried out |

## Activities

| 1.1 Rehabilitation hatchery facilities and other abandoned fish farms | 1.1.1: Conducting studies on transformational conservation and commercialization |
| 1.2 Increased production in existing hatcheries and creation of new centers of production | 1.2.2: Hold meeting (booking) for producers and farmers to learn new knowledge on conservation and transformation |
| 1.3 Research of national agricultural product existing in the country in order to make local feed | 1.3.3: Evaluation of resources and aquaculture potential |
| 1.4 Production of feed for stocking lake and cultivation to private sectors | 1.4.4: Distribution material of transformational and conservation |
| 1.5 Shooting of water bodies (250,000 lbs of fish + 50 artificial cormans) | 1.5.5: Conduct feasibility study for mariculture |
| 1.6 Develop broodstock management program | 1.6.6: Conduct survey on marine species for mariculture |
| 1.7 Distribution of seeds to all state bodies | 1.7.7: Collected data for broodstock management and establishment of a cultivation plan |
| 1.8 Marine hatchery management and laboratory management | 1.8.8: Monitoring and evaluating activities |
| 1.9 Mariculture production process | 1.9.9: |
| 1.10 | 1.10.10 |

## Inputs

| 1.1: Project Director |
| 1.2: Project Manager |
| 1.3: Secretary |
| 1.4: Accountant |

| 2.1: President |
| 2.2: Secretariat |
| 2.3: Comptroller |
| 2.4: Administration |
| 2.5: Materials |
| 2.6: Equipment |

| 3.1: Ministries |
| 3.2: Administations |
| 3.3: Institutions |
| 3.4: Agencies |
| 3.5: Organizations |
| 3.6: Private sector |

| 4.1: Food |
| 4.2: Fish |

---

87
<table>
<thead>
<tr>
<th>Activity</th>
<th>Inputs</th>
<th>Activities</th>
<th>Narrative Summary</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Retrofit hatchery infrastructure</td>
<td>Personal:</td>
<td>2.1 Conduct comprehensive market analysis and promotion study</td>
<td>1. Increased sales of live fish/hatchery plates fish</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>- Hatchery extension expert (field officers)</td>
<td>2.2 Increase access to market</td>
<td>2. Increased hatchery sales and fingerling supply</td>
<td></td>
</tr>
<tr>
<td>1.2 Retrofit production ponds</td>
<td>Equipment and materials:</td>
<td>2.3 Increase income generated by fish farmers</td>
<td>1. Consumption of tilapia increased by 25%</td>
<td></td>
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<tr>
<td></td>
<td>- Vehicles for feed delivery</td>
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<td></td>
<td>- Large boxes and assessors</td>
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<td></td>
<td>- Treadle and measuring devices</td>
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<tr>
<td></td>
<td>- Inspecting scales</td>
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</tr>
<tr>
<td>1.3 Conduct boid oysters and tilapia</td>
<td>Facilities:</td>
<td>2.4 Strengthening the capacity of extension services</td>
<td></td>
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<tr>
<td></td>
<td>- Office space</td>
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<tr>
<td>1.4 Develop boid oysters management programme</td>
<td>Contract:</td>
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<tr>
<td></td>
<td>- Supportive equipment</td>
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<tr>
<td>1.5 How and what staff in hatchery production technologies</td>
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<tr>
<td></td>
<td>- Conducting outreach and education in offsite activities</td>
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<tr>
<td>1.6 Process appropriate delivery apparatus and vehicles</td>
<td>Others:</td>
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<tr>
<td></td>
<td>- Process control room</td>
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<tr>
<td></td>
<td>- Feedstock</td>
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<tr>
<td>1.7 Develop production sector partnerships for improving or</td>
<td></td>
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<tr>
<td></td>
<td>- Production sector partnership for improving or improving</td>
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<tr>
<td>1.8 Identify farmer group for increasing</td>
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<td>1.9 Assess farmer group capacity</td>
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<td>1.10 Train farmer group in by and targeting management</td>
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<td>1.11 Develop targeting production model for future</td>
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</tbody>
</table>
## Project Description

**Country:** Suriname  
**Project Title:** Establishment of a research and training center for aquaculture  
**Target Group:** Aquaculture Farmers  
**Project Period:** 5 Years  
**Target Area:** Coastal Area (Coroni and Commewijne district)

### Overall Goal

The development of Aquaculture in Suriname

### Project Purpose

Improve management and technical skills of aquaculture farmers

### Outputs

1. **Update information on the cultivation techniques of different species of food- and ornamental fish**
   - 1.1. Increase the cultivation of different species of food- and ornamental fish in Suriname
   - 1.2

2. **Increase awareness of aquaculture development**
   - 2.1. Three (3) training courses in aquaculture on ornamental fish
   - 2.2. Five (5) farmers in Darien region, and six (6) farmers in Moruga region

3. **Improve the efficiency of aquaculture farms**
   - 3.1. Increase productivity of aquaculture farms, with at least 50 kg/ha per year

### Activities

<table>
<thead>
<tr>
<th>Activities</th>
<th>Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Survey on native species in collaboration with the universities of Suriname (RUBSUS)</td>
<td>Personal: Fisheries department extension officers and farmers.</td>
</tr>
<tr>
<td>1.2 Inventory of available information on cultivation of native species</td>
<td>Equipment and Materials: Training manual and training programs.</td>
</tr>
<tr>
<td>1.3 Literature and field studies on culturing species for aquaculture (food- and ornamental fish) of economic interest</td>
<td></td>
</tr>
<tr>
<td>1.4 Selection of native species to be cultivated based on literature and field studies on biology, habitat, food, etc.</td>
<td>Facilities: Aquaculture center building with training facilities and offices.</td>
</tr>
<tr>
<td>1.5 Pilot project for cultivation of previously selected species</td>
<td></td>
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<tr>
<td>1.6 Evaluation of the results of pilot project</td>
<td></td>
</tr>
<tr>
<td>1.7 Expansion of cultivation programs for selected species based on evaluation of results of pilot projects</td>
<td></td>
</tr>
<tr>
<td>1.8 Computation of a sustainable model for Suriname with the cultivation model that has been satisfactorily tested</td>
<td></td>
</tr>
</tbody>
</table>

### Indicators

<table>
<thead>
<tr>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Gradual increase of aquaculture activities in Suriname.</td>
</tr>
<tr>
<td>2. Have at least 10 aquaculture farms in production after 5 years.</td>
</tr>
</tbody>
</table>

**Operational Goal:** To be determined
<table>
<thead>
<tr>
<th>Overall Goal</th>
<th>Narrative Summary</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To create national capability in aquaculture expertise through trained and sensitised stakeholders for aquaculture development</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project Purpose</th>
<th>Narrative Summary</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To provide training to farmers, extension personnel and labourers.</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outputs</th>
<th>Narrative Summary</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Farmers Trained</td>
<td></td>
<td>1.1 25 farmers trained</td>
</tr>
<tr>
<td>2 Extension Staff Trained</td>
<td></td>
<td>2.1 10 extension officers trained</td>
</tr>
<tr>
<td>3 Labour Force Sensitised and Prepared for Aquaculture Work on Aquaculture Enterprises</td>
<td></td>
<td>3.1 60 Labours trained</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activities</th>
<th>Narrative Summary</th>
<th>Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Prepare awareness materials to promote training and availability of technical support</td>
<td></td>
<td>Personnel:</td>
</tr>
<tr>
<td>1.2 Prioritise the availability of training for established and potential farmers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3 Conduct selection process if necessary to keep groups at a manageable size over several cycles of training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.4 Develop training materials for the programme and budget for achieving the output</td>
<td></td>
<td>Equipment and Materials:</td>
</tr>
<tr>
<td>1.5 Conduct selection process if necessary to keep groups at a manageable size over several cycles of training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.6 Conduct training and evaluation of training</td>
<td></td>
<td>Facilities:</td>
</tr>
<tr>
<td>1.7 Conduct monitoring and feedback to determine effectiveness of exercise and need for adjustments</td>
<td></td>
<td>Operational Cost:</td>
</tr>
<tr>
<td>1.8 Make adjustments to training materials and programme where necessary</td>
<td></td>
<td>Others:</td>
</tr>
<tr>
<td>1.9</td>
<td></td>
<td></td>
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<tr>
<td>1.10</td>
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</tbody>
</table>

90
Appendix VIII: Formation of a Regional Network of Aquaculture Organisations

Formation of a Regional Network of Aquaculture Organisations

by
Terrence Phillips
CRFM Secretariat

CARICOM/CRFM/JICA First Regional Aquaculture Development Planning Workshop
Jamaica, March 14 – 22, 2011

Outline

- Definition of a network
- Examples of networks
- NACA model
- Proposed CARICOM/CRFM network of aquaculture organisations
Definition of a network

Network - set of actors/entities (nodes) linked by specified relationships/interactions (ties).

Networking is the strategic effort to build and cultivate relationships that provide you with a system to advance issues and meet specific needs:

- Cultivate growth
- Communicate vision to partners
- Open and supportive.

Examples of networks

What are general examples of networks?

Networks are everywhere. We talk about them all of the time … network of friends, road network, telephone network, etc.

What they have in common are people and places joined together by relationships.

What are some other networks?
Examples of networks cont’d: LIAT – regional network of routes, hubs

Examples of networks cont’d: Al Qaeda – international network of terrorist cells
Examples of networks cont’d: ICCAT - international to local tuna management showing various levels of organizations

Network of Aquaculture Centres in Asia and the Pacific (NACA) model (Source: NACA website)

**NACA agreement:** formation, objectives and governance of NACA are set out in the Agreement

**Vision**
NACA is an IGO that promotes rural development through sustainable aquaculture.

Seeks to improve rural income, increase food production and foreign exchange earnings and to diversify farm production. Ultimate beneficiaries: farmers and rural communities.

Core activities of NACA are:
- Capacity building through education and training
- Collaborative research and development through networking among centers and people
- Development of information and communication networks
- Policy guidelines and support to policies and institutional capacities
- Aquatic animal health and disease management
- Genetics and biodiversity.
Network of Aquaculture Centres in Asia and the Pacific (NACA) cont’d

Structure
NACA policy is determined by the Governing Council composed of senior officials representing the member governments. GC meets once a year. Also, formulates NACA’s 5-Year Regional Work Programme.

Agreement: Allows other international and government assistance agencies to be non-voting members by invitation. FAO is a non-voting member.

Members
Australia, Bangladesh, Cambodia, China, Hong Kong SAR, India, Indonesia, I.R. Iran, Korea (DPR), Lao PDR, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Thailand, Vietnam.

Collaborating agencies
Partnerships with governments, donor foundations, development agencies, universities and a range of non-governmental organisations and farmers. For example UNDP, Asian Dev. Bank, World Bank, NORAD.

Proposed CARICOM/CRFM network of aquaculture organisations

Likely objectives (reference NACA agreement)
To assist in the regional and national efforts to expand aquaculture development mainly for the purpose of:

- increasing production
- improving rural income and employment
- diversifying farm production
- increasing foreign exchange earnings and savings.

To facilitate the achievement of these objectives:
- establish a network of aquaculture and related organisations to share the responsibility of research, training and information exchange essential to aquaculture development in the region
- strengthen institutional and personal links among national and regional organisations through the exchange of technical personnel, technical know-how and information
- promote regional self-reliance in aquaculture development through TCDC
- promote the role of women in aquaculture development.
Composition and functions of the network

**Likely composition:** DOFs, regional and national universities, other aquaculture related training and research institutions, national and regional aquaculture stakeholder organizations and the CRFM.

**Likely functions**
To achieve these objectives, the network could undertake the following:

- conduct disciplinary and interdisciplinary research on selected aqua-farming systems for adaptation or improvement of technologies, and for the development of new technologies
- train and upgrade core personnel needed for national aquaculture planning, research, training, extension and development
- establish a regional information system to provide appropriate information for development planning, research and training

**Composition and functions of the network cont’d**

**Likely functions cont’d**
- assist members in strengthening their national organisations linked to the regional organisations
- assist the national organisations in testing and adapting existing technology to local requirements and in the training of technicians, extension workers and farmers at the national level
- transfer to the national organisations appropriate aquaculture technologies and techniques developed at regional organisations
- facilitate the exchange of national experts, technical know-how and information within the framework of TCDC
- develop programmes for the promotion of women’s participation in aquaculture development at all levels
- assist members in feasibility studies and project formulation.
Vision, Goal of Master Plan and Strategy

• Vision:
The sustainable use of fisheries resource by coastal community is promoted.

• Goal:
Coastal community and fisheries department take measures for the sustainable use of fisheries resources.
Strategy

• Diversification of Fishery
  Artisanal fishermen can realize rational utilization of multi fisheries resource, in accordance with the resource condition and from the perspective of the sustainability.

• Creation of Alternative Income
  Excessive fishing effort on the overfished fisheries resource in reef and island shelf resource is reduced.

• Encouragement of Local Community Participation toward Co-management.

Basic Understandings in Small Scale Aquaculture Development

• The market of the small scale aquaculture products is domestic/local export market. Aquaculture shall be considered as an income generating activity and beyond subsistence-back yard aquaculture.

• Tilapia is the main culture species. However, other species that have strong demand will be also considered.
Common Issues on Small Scale Aquaculture Development

1. Aquaculture Development Policy does not exist/ inadequate or not adopted.
2. Input cost of production is too high to compete in domestic as well as international market.
3. Aquaculture promotion and extension service is weak.
4. Quality and quantity of seed stock production is inadequate.

1. Aquaculture Development Policy does not exist/ inadequate or not adopted.
   • Political will is lacking
   • Inadequate communication among stakeholders
   • Inadequate communication with policy makers
   • Weak or unproven rationale to develop aquaculture (economic advantage compare to other agriculture products or other economic activities such as housing)
   • Many failures in the past.
   • Need to redefine the role of aquaculture development
Some Example of Aquaculture Development Policy

• Creation and or diversification of the job opportunity
• Food security and safety (nation as well as region)
• Fisheries resource management
• Land use and zoning for aquaculture development
• Financial support/credit for aquaculture development
• Import tax, excise tax exemption for equipment necessary for aquaculture

2. Input cost of production is too high to compete in domestic as well as international market.

• Feed cost is too high. Need to develop feed with locally available ingredients.
• Security cost to prevent theft is too high.
• Energy (electricity) cost is too high.
• Preparation for the hurricane damage

In some countries

• Labor cost is too high
• Land cost is too high
3. Aquaculture promotion and extension service is weak.

- Inadequate number of extension staff
- Insufficient training and follow up for extension staff
- Insufficient training and follow up for fish farmers
- Insufficient promotion to consume cultured fish
- Insufficient facility and equipment for demonstration pond

4. Quality and quantity of seed stock production is inadequate.

- Seed production capacity at the government hatchery is insufficient.
- Brood stock is inadequate.
- Intermediate size seed stock culture business has not been developed in the Private sector or community level.
- Seed stock production of alternative species is not sufficient.
4. Quality and quantity of seed stock production is inadequate.

- Seed production capacity at the government hatchery is insufficient.
- Brood stock is inadequate.
- Intermediate size seed stock culture business has not been developed in the Private sector or community level.
- Seed stock production of alternative species is not sufficient.

Regional cooperation through Aquaculture Network and Centers of excellences

- Utilizing regional institutions and private sectors as much as possible (collaboration of industry, public, and academia)

- Formulation of guideline/framework of aquaculture development policy

- Research and Development
  - Local Feed Development
  - Tilapia culture technical improvement
  - Alternative species culture development
  - Marketing survey
  - Socio economic survey
Appendix X: Potential Role of the University of the West Indies (UWI) in Regional Aquaculture Development

Potential roles of the University of the West Indies (UWI) in Regional Aquaculture Development

First Regional Workshop on Aquaculture Development Planning
March 14-21, 2011
Jamaica, W.I.

ACN Phillips
UWI, St. Augustine

The University of the West Indies (UWI)

- Mona Campus (Jamaica)
- Cave Hill Campus (Barbados)
- St. Augustine Campus (Trinidad and Tobago)
- 16 member countries in the English-speaking Caribbean
Anguilla
Antigua and Barbuda
Bahamas
Belize
Bermuda
British Virgin Islands
Cayman Islands
Dominica
Grenada
Montserrat
St. Kitts and Nevis
St. Lucia
St. Vincent and the Grenadines

The University of the West Indies
(UWI)

The University of the West Indies
(UWI) has evolved from a fledgling college in Jamaica with
33 students to a fully-recognized university with over 40,000
students. Today, UWI is the largest and most longstanding
higher education provider serving over 20 countries in the
English-speaking Caribbean, with traditional campuses in
Barbados (Cave Hill), Jamaica ( Mona) and Trinidad and Tobago
(St. Augustine). UWI recently initiated its Open
Campus, a multi-option and multi-mode online campus with
over 40 physical site locations across the region in
Anguilla, Antigua & Barbuda, The Bahamas, Belize, British Virgin Islands, Cayman Islands, Dominica, Grenada,
Montserrat, St. Christopher (St. Kitts) & Nevis, St. Lucia, and St. Vincent & the Grenadines. UWI is an international
University with faculty and students from over 40 countries and collaborative links with over 20 universities
around the world. Through its seven Faculties, UWI offers undergraduate and postgraduate degree options in Engineering,
Humanities & Education, Law, Medical Sciences, Pure & Applied Sciences, Science and Agriculture, and Social
Sciences.

UWI Mission Statement
The enduring mission of the University of the West Indies (UWI) is to propel the economic, social, political and cultural
development of West Indians society through teaching, research, innovation, advisory and community services and
intellectual leadership. (UWI Strategic Plan 2007-2012)
UWI- Department of Food Production

- Moringa oleifera
  (Miracle Tree, Horseradish Tree, Drumstick Tree, Ben Oil Tree)

- New feed formulations and analyses
- Digestibility studies
- Controlled clinical studies
- Lowered Feed Conversion Ratios (FCR)
- Dissemination of research findings
TRAINING WORKSHOPS

UWI-
Department of Food Production
School of Veterinary Medicine

- Aquaculturists
- Veterinarians
  - Production systems
  - System design
  - Fish health and fish health management
  - Principles of biosecurity
  - Updates on emerging diseases
  - Food safety
DIAGNOSTICS

UWI-
School of Veterinary Medicine

Aquatic Animal Health Diagnostic Laboratory
- Necropsy
- Bacteriology
- Histopathology
- Toxicology
- Molecular diagnostics
- Water Quality Testing
SUSTAINABILITY
AND
ENVIRONMENTAL
IMPACT

UWI-
Centre for Resource Management
and Environmental Studies

- Research on sustainable development
- Ecosystems approach to aquaculture and species management
- Advisory services
- Applied consulting services
UWI-
Schools of Business and Law

- Training in principles and practices of project management

- Projects on policy development, revision of commercial trade policy

- Analysis, review and development of environment-related policies, and articulation of policy positions in response to emerging environmental issues and events
YOUTH INVOLVEMENT

UWI-
Department of Food Production,
SVM, CERMES

- Outreach/Awareness campaigns
  - Primary and Secondary Schools
    - Science Fair displays/demonstrations
    - Projects designed for various age groups
      - Bring aquaculture to the classroom
  - Undergraduates
    - Design a pool of research projects based on industry needs
      - Personal experience...
Additional Faculties/Departments

- Engineering
  - Region/climate-appropriate technology development

SUMMARY

The UWI can play a strong supportive role in regional aquaculture development through:

- Outreach
- Undergraduate/Graduate education
- Applied research
- Needs-based projects
- Professional training
- Continuing education
- Cooperative initiatives linking researchers with private sector and governmental stakeholders
THANK YOU

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Coordinator - Aquaculture/Aquatic Animal Health Unit
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The University of the West Indies
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Email: Carla.Phillips@sta.uwi.edu; phillipsacn@gmail.com