Cluster Development Plan

Project Title: Belize Shrimp Biosecurity Aquaculture Zone Management

Cluster Name: Belize Shrimp Cluster

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CCPF overview and purpose of the CDP

To support the competitiveness of the Belize Shrimp Cluster this Cluster Development Plan (CDP) focuses on establishing a Biosecurity Aquaculture Zone Management Plan (BAZMP) among Belizean shrimp growers and other key industry players. An outbreak of Early Mortality Syndrome (EMS) in 2015 crippled the Belize Shrimp Cluster's production resulting in a severe decline in income, employment and foreign exchange earnings. The BAZMP seeks to put the necessary biosecurity infrastructure and capabilities in place that enable the Belize Shrimp Cluster to continue to be internationally competitive in premium export markets by reducing disease risks and maintaining and sustaining production levels and sustainable agriculture and good labor practices. This will permit the industry to continue being an important component of Belize's economy in terms of foreign exchange, contribution to GDP and rural employment and is characterized by sustainable agriculture and good labor practices, while also providing a solid foundation for strong market positioning and growth. Sustain

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List of Abbreviations and Acronyms

ASC – Aquaculture Stewardship Council
AHPND – Acute Hepatopancreatic Necrosis Disease
BAHA – Belize Agricultural Health Authority
BAL – Belize Aquaculture Limited
BSGA – Belize Shrimp Growers Association
CAGR – Compound Annual Growth Rate
CCIP – Cluster Competitiveness Improvement Plan
CCPF – Compete Caribbean Partnership Facility
CDP – Cluster Development Plan
DFC –Development Finance Corporation
DoE – Department of Environment
EMS – Early Mortality Syndrome
EU – European Union
GDP – Gross Domestic Product
IDB – Inter-American Development Bank
MoA – Ministry of Agriculture
SWOT – Strengths, Weaknesses, Opportunities, Threats
US – United States of America
WWF – World Wildlife Fund

Executive Summary

Context and Rational for this Cluster Project

Belize benefits from favorable conditions for shrimp aquaculture production, with a tropical climate, easy access to clean seawater and the availability of low-skilled labor. These enabling conditions have helped facilitate sustainable shrimp production and development, primarily in southern Belize in the Stann Creek region. Further, as part of a Compete Caribbean Partnership Facility-funded (CCPF) project during Phase 1 of the program, participant farms within the Belize Shrimp Growers Association (BSGA) collaborated together to implement better management practices to comply with the social and environmental standards of the Aquaculture Stewardship Council (ASC) standards.

Leveraging these favorable conditions and the high degree of market focus provided by ASC certification, the firms in the Belize Shrimp Cluster converted these comparative advantages into competitive ones and successfully opened new premium export markets in Europe demanding high quality shrimp produced under strict social and environmental practices. In doing so, the shrimp industry evolved into an important component of the Belizean economy becoming a key source of foreign exchange for the country and a major employer in Southern Belize.

The Belizean shrimp industry has generated about two thousand direct jobs when operating at full capacity. In April 2015, 95% of the Belize's shrimp production was certified under the Aquaculture Stewardship Council (ASC) standards, permitting access to premium markets.

These premium markets generated better margins for producers than the fluctuating commodity prices. Export sales reached a historical peak of US$45 million in 2014. In addition, production reached 15.9 million pounds and the Belize fishing industry, including shrimp aquaculture, represented 5.6% of the country's total GDP in 2014

However, in 2015 shrimp production was severely affected by an Early Mortality Syndrome (EMS) outbreak, reducing production by 41% with respect to 2014 production crop, and subsequent significant declines in income, employment and foreign exchange earnings. Firm revenues and Belize's corresponding hard currency earnings from shrimp production operations declined considerably from over US$45 million in 2014 to US$28 million in 2015 to less than US$8 million in 2016. During this period employee earnings in the shrimp industry nearly doubled between 2012 and 2014, from US$3.2 million in US$6 million, before dropping to US$1.7 million in 2015. Shrimp industry

employment witnessed similar declines with full time employment falling between 2014 and 2015 from 700 to 302 and part time seasonal labor from 750 to 412. And as processing plants are not operating at full capacity and women are primarily employed in the plants, women have been severely impacted.

The shrimp industry has continued to struggle to recover from this outbreak to reach 2014 production, income, export and employment levels and the shrimp industry is one of southern Belize's most important industries both in terms of income and employment. The contraction the industry experienced as a result of the EMS outbreak was widely felt in neighboring communities that had become significantly reliant on income derived from the industry and the tourism industry was unable to absorb all of the labor force that was laid off during the contraction. Consequently, the local economy remains largely depressed.

To improve the predictability of production systems and the performance of shrimp farms and begin to take advantage of premium niche market opportunities again, the control of diseases is going to be the main challenge for the Cluster. Creating standards and consistency amongst Cluster actors will be key towards the Cluster's ability to both, recover from this EMS outbreak and to mitigate risks associated with potential future disease outbreaks. There is widespread acknowledgement amongst Cluster actors that particularly when it comes to biosecurity issues, the Cluster is only as strong as its weakest link. Given this heightened degree of interdependence, the rationale for clustering and acting collectively is clearly understood by Cluster actors.

Main Goals and Objectives

The purpose of the CDP is to provide a roadmap for the creation and implementation of a Biosecurity Aquaculture Zone Management Plan (BAZMP) among Belizean shrimp growers. It is anticipated that implementing the BAZMP will create conditions to reduce disease risks, improve the performance predictability of shrimp production and maintain and sustain its international competitiveness in premium ASC-certified export markets, thereby continuing to be an important component of Belize's economy in terms of foreign exchange, contribution to GDP and rural employment characterized by good labor practices and conditions as required by ASC.

Specific commercial and socioeconomic goals that this project aims to achieve by September 2020 include:

- Improved predictability of shrimp production recovering to at least 2014 production levels;
- Annual sales of US$50 million;
- Achieving 25% of national exports into premium markets;
- Achieving a 25% mark-up above commodity market prices;
- Increased premium seafood market access in Europe and North America; and,

- Create 1,000 additional job opportunities for rural communities in Southern Belize.

In parallel, as commercial and socioeconomic goals are integrally tied to improved biosecurity conditions, specific biosecurity-related goals that this project aims to achieve by September 2020 include:

- Creation of a functioning Biosecurity Aquaculture Zone Management Plan (BAZMP) that standardizes production and biosecurity practices and has clear response measures;
- Functioning standardized and systematic surveillance and monitoring data collection system in place;
- Functioning early warning system for data collection and epidemiological data analysis in place;
- Trained technical staff that are accessible to all farms with in-house capacities to better monitor shrimp diseases and improve early responses to diseases.. Initially, at least one technical staff per farm is targeted; and,
- New biosecurity standards and regulations in place and enforced to regulate sustainable and competitive shrimp production in Belize.

Components and Activities

The proposed Project is comprised of three primary components:

1. **Design and Implement Biosecurity Aquaculture Zone Management Plan (BAZMP).** This will involve implementing a Biosecurity Aquaculture Zone Management Plan (BAZMP) along Belize's shrimp aquaculture zone to prevent and/or control shrimp diseases and activities to develop, adopt and enforce mandatory regulations for biosecurity. The BAZMP will cover all Belizean shrimp farms and hatcheries, including supply and receiving water bodies and the industry will define and agree on requirements that will be first adopted voluntarily but with the vision that they will become mandatory regulations that will be enforced.
2. **Design and Implement a Surveillance and Monitoring System to Prevent Shrimp Disease Outbreaks.** This will involve implementing a Surveillance and Monitoring System to prevent or control shrimp disease outbreaks along Belize's shrimp aquaculture zone and associated activities to enhance monitoring and data analysis capabilities by establishing and improving surveillance programs of shrimp health and production information (water quality, pond management etc.), and develop capacity for epidemiological analysis of data.
3. **Establish Capacity Building Program for Cluster Members.** This will involve capacity building activities that develop new knowledge and expose cluster members to new technologies on best production methods for preventing

disease, and transfer to participants through training and information sharing.

Stakeholders

The core of the shrimp Cluster is comprised of 5 hatcheries, 13 farms, and 4 processing plants that add value to products in the form of peeled and cooked shrimp. The core Cluster actors rely on a complex network of suppliers and support organizations to maintain competitiveness, from feed and broodstock suppliers to ground and sea transportation providers to port and electricity infrastructure and specialized financial firms (among others). In addition, the World Wildlife Fund (WWF) has been an important partner to the Cluster, helping steward Cluster actors through the Aquaculture Stewardship Council (ASC) certification process and continues to be an important source of best practices as the industry recovers from the EMS outbreak.

The shrimp aquaculture industry formally organized under the Belize Shrimp Growers Association (BSGA) in 1996 and the association currently represents 90% of total Belizean shrimp production. A strong culture of collaboration has emerged organically in the BSGA, both internally and externally (with governmental institutions and NGOs) and the BSGA has consistently engaged in processes to minimize the industry's negative environmental impact and association members have regularly participated in joint projects such as achieving ASC certification, and knowledge and equipment sharing.

It is also important to note that as biosecurity issues have become increasingly central to the shrimp industry's competitiveness, a number of regulatory and support organizations' roles in the Cluster's competitiveness have become more pronounced. For example, the Belize Agricultural Health Authority's (BAHA) capabilities to monitor for diseases, provide technical assistance on disease planning and response procedures and enforce phytosanitary measures have become critically important, as has the Ministry of Agriculture's (MoA) and Department of Environment's (DoE) enforcement of environmental compliance measures. The International Regional Organisation for Plant and Animal Health (OIRSA) is also an important Cluster support organization through its role establishing phytosanitary standards.

Simultaneously, as most commercial banks have lowered their exposure to the shrimp industry during the EMS outbreak and recovery period, government financial institutions such as the Development Finance Corporation (DFC) and Social Security Board have become increasingly important sources of financing.

The BAZMP will be a critical tool to bring predictability to shrimp production in Belize, its implementation will ensure proper management practices and a monitoring program can successfully prevent disease outbreaks in the shrimp production zone thereby guaranteeing shrimp production. To be fully adopted and functional, the BSGA and the Belize Agricultural Health Authority (BAHA), will continue their ongoing collaboration

establishing a policy making body with a mandate to fully adopt the BAZMP. A BSGA/BAHA technical group will monitor the level of compliance with regulations, discuss and assess weaknesses and challenges and propose periodic improvements for strengthening pathogen and disease controls. The BSGA will ensure communication with relevant government agencies on the evolution of the industry situation and needs for amending regulations.

Overall Budget and Private Sector Contribution

The total estimated budget of the proposed project is US$543,000. This proposed budget is comprised of US$400,000 CCPF investment (including US$10,000 investment in goods to purchase cloud-based software to host an online database to establish relationships between pond conditions and the prevalence of pathogens), and US$72,000 and US$71,000 in Cluster Cash and In-kind contributions respectively.

The cash contribution will consist of 8 shrimp farms applying for ASC recertification, @US$9,000 per farm. The Cluster will make its in-kind contribution through contributing technical and managerial staff time throughout the project. In-kind contributions will particularly intensive in relation to the farms' laboratory technicians contributing time towards activities related to intensifying and improving the pathogens surveillance and monitoring in Belize's shrimp production zone.

It is anticipated that this type of investment in the Cluster's biosecurity infrastructure and capabilities will be key to remaining competitive globally, permitting the Cluster to both, manage potential future disease breaks more effectively while also providing a solid foundation for strong market positioning and growth.

Timeline

With the Belize Shrimp Biosecurity Aquaculture Zone Management (Project) the Belize Shrimp Cluster (Cluster) aims to improve shrimp production and support farm rehabilitation over a project time frame of 2 years to bring Belizean total sales back to the 2014 level of about US$50 million by December 2020 and create up to 1,000 additional jobs for workers from surrounding rural communities in southern Belize.

I. Context

1.1 Opportunity/Problem Statement and Rationale for Clustering

Belize benefits from favorable conditions for shrimp production, with a tropical climate, easy access to clean seawater and the availability of low-skilled labor. These enabling conditions have helped facilitate sustainable shrimp production and development, primarily in southern Belize in the Stann Creek region. [1] Further, as part of a Compete Caribbean Partnership Facility-funded (CCPF) project during Phase 1 of the program, participant farms within the Belize Shrimp Growers Association (BSGA) collaborated together to implement better management practices to comply with the social and environmental standards of the Aquaculture Stewardship Council (ASC) standards. [2]

Leveraging these favorable conditions and the high degree of market focus provided by ASC certification, the firms in the Belize Shrimp Cluster converted these comparative advantages into competitive ones and successfully opened new premium export markets in Europe demanding high quality shrimp produced under strict social and environmental practices. In doing so, the shrimp industry evolved into an important component of the Belizean economy becoming a key source of foreign exchange for the country and a major employer in Southern Belize.

However, in 2015 shrimp production was severely affected by an Early Mortality Syndrome (EMS) outbreak, [3] reducing production by 41% with respect to 2014 production crop, and subsequent significant declines in income, employment and foreign exchange earnings. The shrimp industry has continued to struggle to recover from this outbreak to reach 2014 production, income, export and employment levels.
The project concept put forward in this Cluster Development Plan (CDP) aims to markedly improve the Cluster's biosecurity capabilities and infrastructure, thereby

[1] Belize has a lot of empty land, great water quality, available labor, and it's close to the USA market. Belizean workers tend to be loyal and hard working. Additionally, the government has been supporting shrimp farming: It set up land concessions for shrimp farms and granted them tax-free status. All those factors had a lot to do with the industry getting started. Source: http://www.shrimpnews.com/FreeReportsFolder/HistoryFolder/HistoryWesternHemispher/ThorntonLinda.html

[2] ASC's, "standards for responsible aquaculture address the key environmental impacts of farming, set requirements for workers' rights and protect communities surrounding certified farms." See the following link for a thorough description of ASC environmental and social requirements specifically for shrimp farming: https://www.asc-aqua.org/what-we-do/our-standards/farm-standards/the-shrimp-standard/

[3] "Early Mortality Syndrome (EMS) or Hepatopancreatic Acute Necrosis Syndrome is a fairly new disease that affects shrimp…. caused by the bacterial agent Vibrio parahaemolyticus, which is transmitted orally and colonizes the shrimps gastrointestinal tract. This then produces a toxin that causes tissue destruction and dysfunction of the shrimp digestive organ…[and] is characterized by high mortalities, with many cases reaching 100 per cent within the first 30 days". Source: https://thefishsite.com/disease-guide/early-mortality-syndrome

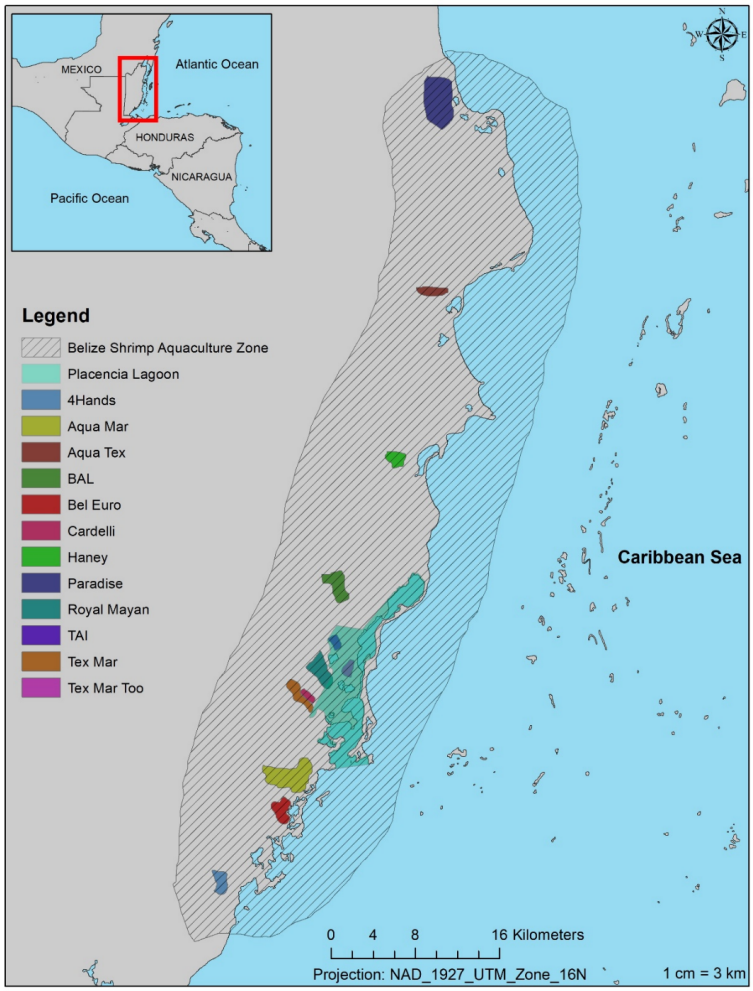
improving production and supporting farm rehabilitation to bring production, sales, exports and employment back to 2014 levels.

There is widespread acknowledgement amongst Cluster actors that particularly when it comes to biosecurity issues, the Cluster is only as strong as its weakest link. Given this heightened degree of interdependence, the rationale for clustering and acting collectively is clearly understood by Cluster actors.

1.2 Sector Involved and Contribution to the Belizean Economy

Belize's shrimp industry is an important component of the country's economy. Shrimp farming has developed in lands deemed of low value for agriculture or tourism, and away from the coastline and therefore not competing with touristic development. The industry is heavily concentrated in southern Belize in the Stann Creek District and also benefits from the availability of low-skilled labor from rural communities in the region:

Figure 1: Location of Shrimp Farms in Belize



Source: Belize Shrimp Growers Association

Production and exports have fluctuated, but have more or less steadily grown over time with production increasing by 20% annually between 2011 and 2014:

Figure 2: Belize Shrimp Production 1995 -2015 (pounds)

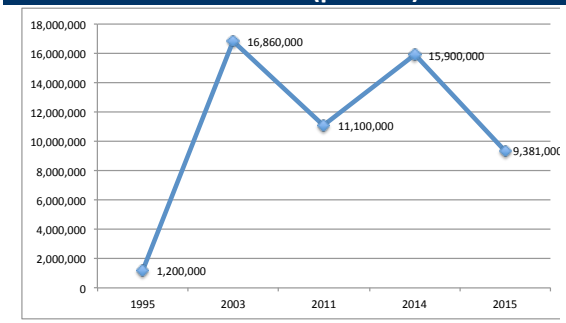
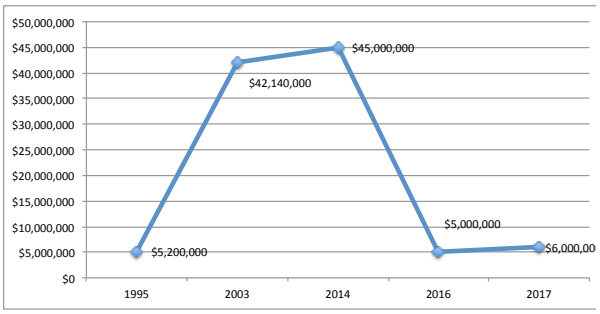


Figure 3: Belize Shrimp Exports 1995-2017 (US$) *



Source: Belize Shrimp Growers Association
https://www.seafoodsource.com/news/aquaculture/ems-ravaged-shrimp-sector-bounces-back-in-belize
http://www.fao.org/fishery/countrysector/naso_belize/en
* 2017 export figures are projections

The Belizean shrimp industry generates about two thousand direct jobs when operating at full capacity. In April 2015, 95% of the Belize's shrimp production was certified under the Aquaculture Stewardship Council (ASC) standards, permitting access to premium markets.

These premium markets generated better margins for producers than the fluctuating commodity prices. Export sales reached a historical peak of US$45 million in 2014. In addition, production reached 15.9 million pounds and the Belize fishing industry, including shrimp aquaculture, represented 5.6% of the country's total GDP in 2014.

However, in 2015 the shrimp industry was severely affected by an outbreak of Early Mortality Syndrome (EMS), which reduced production by 41% from 2014 production levels. The industry has continued to struggle to recover from this outbreak to reach 2014 production, export and employment levels.

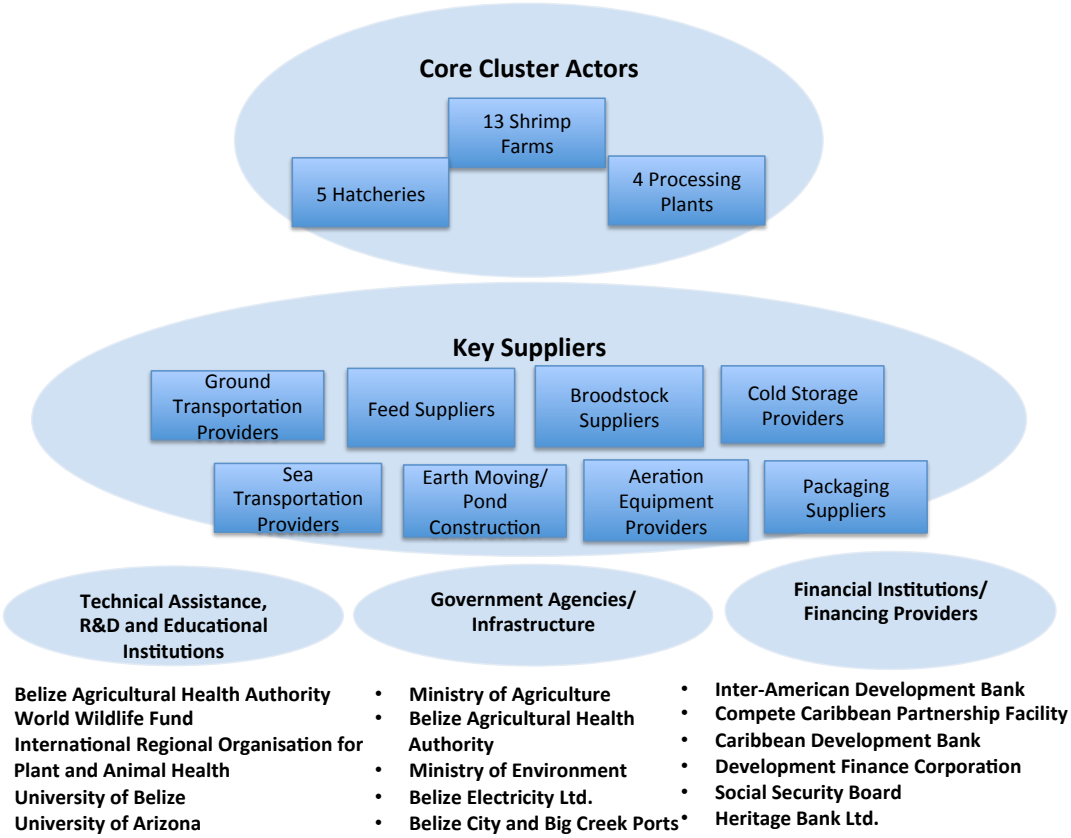
The main factors affecting the growth of the sector in Belize continue to be outbreaks of diseases, access to new improved genetic material to improve shrimp production, access to trained staff and access to the service industry (design, construction, freight and logistics, bio-analysis, accredited laboratories in country).

1.3 Cluster Map

The cluster mapping exercise shed light on the main players in the Cluster including producers/exporters, suppliers and related economic infrastructure institutions and the

key linkages, externalities and synergies that bind these individual entities into a cluster. The diagram below aims to visually capture the Belize Shrimp Cluster's basic structure, and configuration:

Figure 4: Belize Shrimp Cluster Map



Source: Consultant's analysis

As the diagram above suggests, the core of the shrimp Cluster is comprised of 5 hatcheries, 13 farms, and 4 processing plants that add value to products in the form of peeled and cooked shrimp. The farms range from extensive, semi-intensive, intensive to super-intensive production systems and the core Cluster actors rely on a complex network of suppliers and support organizations to maintain competitiveness, from feed and broodstock suppliers to ground and sea transportation providers to port and electricity infrastructure and specialized financial firms (among others). In addition, the World Wildlife Fund (WWF) has been an important partner to the Cluster, helping steward Cluster actors through the Aquaculture Stewardship Council (ASC) certification process and continues to be an important source of best practices as the industry recovers from the EMS outbreak. [4]

[4] https://www.asc-aqua.org/a-journey-towards-responsible-shrimp-farming-in-belize/

Further, as the table below depicts, when assessing the composition of core private sector Cluster actors in further detail, three cluster actors are fully integrated with shrimp farm, hatchery and processing operations:

Table 1: Detailed Composition of Core Cluster Actors

Shrimp Farms	Hatcheries	Processing Plants
1. Belize Aquaculture Ltd. 2. Paradise Shrimp Farm C.A. Ltd. 3. Aqua Mar Belize Ltd. 4. Aquasur Shrimp Farm Ltd. 5. Bel Euro Aquaculture Ltd. 6. Cardelli Farms Ltd. 7. Destiny Shrimp Farm Ltd. 8. Four Hands Shrimp Farm Ltd. 9. Golden Crown Farm Ltd. 10. Haneys Shrimp Farm Ltd. 11. Royal Mayan Shrimp Farms Ltd. 12. Tex Mar Ltd. 13. Tropical Aquaculture Investment Ltd.	1. Belize Aquaculture Ltd. 2. Paradise Shrimp Farm C.A. Ltd. 3. Aqua Mar Belize Ltd. 4. Bel Euro Aquaculture Ltd. 5. Aqua Blue	1. Belize Aquaculture Ltd. 2. Paradise Shrimp Farm C.A. Ltd. 3. Aqua Mar Belize Ltd. 4. Rainforest Seafoods Belize Ltd.

Source: Belize Shrimp Growers Association

It is also important to note that as biosecurity issues have become increasingly central to the shrimp industry's competitiveness, a number of regulatory and support organizations' roles in the Cluster's competitiveness have become more pronounced. For example, the Belize Agricultural Health Authority's (BAHA) capabilities to monitor for diseases, provide technical assistance on disease planning and response procedures and enforce phytosanitary measures have become critically important,[5] as has the Ministry of Agriculture's (MoA) and Department of Environment's (DoE) enforcement of environmental compliance measures. The International Regional Organisation for Plant and Animal Health (OIRSA) is also an important Cluster support organization through its role establishing phytosanitary standards.

Simultaneously, as most commercial banks have lowered their exposure to the shrimp industry during the EMS outbreak and recovery period, government financial institutions such as the Development Finance Corporation (DFC) and Social Security Board have become increasingly important sources of financing.

[5] As the 2013 Cluster Competitiveness Improvement Plan (CCIP) for the Belize Shrimp Cluster accurately noted, "there is also a symbiotic relationship between the cluster members and the key technical support agency, BAHA" in that BAHA relies on fees paid by the shrimp industry for technical analyses to fund the organization's operations.

1.4 History of the Cluster

The Belizean aquaculture industry began in 1982, growing slowly to four farms in 1988 to twelve farms in 2003.[6] The industry has been able to overcome several challenges particularly with pest and disease, production inefficiencies and marketing challenges and has grown steadily to become a multi-million-dollar industry.[7] The shrimp aquaculture industry formally organized under the Belize Shrimp Growers Association (BSGA) in 1996 in response to collective disease management challenges, to collectively address waste management issues and to more effectively advocate with government.[8]

The benefits of clustering usually require close proximity of actors to realize networking effects, cost risk sharing, sourcing pooling, collective marketing and promotion efforts etc. With much of the shrimp aquaculture industry concentrated in the Stann Creek District and many shared common challenges, a strong culture of collaboration has emerged organically in the BSGA, both internally and externally (with governmental institutions and NGOs). Since 2004, the BSGA has consistently engaged in processes to minimize the industry's negative environmental impact and association members have regularly participated in joint projects and knowledge and equipment sharing. The BSGA currently represents 90% of total Belizean shrimp production.

This culture of collaboration was further solidified during the first CCPF project during Phase 1 of the program from 2013-2016. As part of this project, participant farms within the Belize Shrimp Growers Association (BSGA) collaborated together to implement better management practices to comply with the social and environmental standards of the Aquaculture Stewardship Council (ASC) standards.[9] 95% of the Belize's shrimp production was certified under ASC standards, permitting the industry to access new premium export markets.

> "In 2012...the [Belize Shrimp Cluster received] a grant of US$500,000 to prepare for and acquire the ASC certification as well as to strengthen the capability of the Cluster…Initially eight farms operating as an economic cluster under the facilitation of the World Wildlife Fund, and accounting for 90% of production in Belize, cooperated and committed to the certification process. In April of 2015 all eight received certification. One

[6] http://www.fao.org/fishery/countrysector/naso_belize/en

[7] White Paper on the Shrimp Industry, Development Finance Company. Oct. 2017. 13p

[8] The BSGA is governed by a Board of Directors and the general assembly. All shrimp growers are members of the BSGA and as a policy making body all decisions are taken by consensus at any called general meeting.

[9] The Aquaculture Stewardship Council (ASC) was founded in 2010 by WWF and IDH (The Sustainable Trade Initiative) to transform aquaculture towards environmental sustainability and social responsibility. The ASC aims to be the world's leading certification and labelling programme for responsibly farmed seafood and is working globally with all stakeholders in the value chain including farmers, processers, retailers, governments, NGOs and consumers. It is intended that attaining ASC certification will:

1) Enable the Belize shrimp farmers to achieve a competitive advantage and privileged access to a high-value market;
2) Provide wider benefits by enabling farms to reduce negative impacts on the surrounding environment; and
3) Promote positive community benefit and social responsibility.

Source: http://www.shrimpgrowers.org/service/asc-certification/

> farm was certified later in the process bringing the total certified farms to nine.
>
> As a direct result, at the farm level, production has increased and the farmers are assured of the value of their production methods to consumers and local stakeholders. The cluster [benefitted] from the opportunity to group and brand production to satisfy high volume orders, and as an industry initiative, the country brand as a credible supplier of quality, responsibly produced shrimp [was] objectively qualified and established." [10]

This CCPF effort helped to solidify a common economic vision within the Cluster, while also helping to form and/or strengthen specific horizontal and vertical linkages between Cluster actors. Cluster stakeholders interviewed report that most Cluster actors recognize their interdependence, are eager to overcome some information-sharing limitations and that the clustering effort within the ASC certification project was critical to the Cluster's development an created a platform from which to continue to pursue common visioning, consensus building and enhanced knowledge sharing.

However, the aforementioned 2015 Early Mortality Syndrome (EMS) or 'acute hepatopancreatic necrosis disease' (AHPND) outbreak crippled production resulting in a severe decline in income, employment and foreign exchange earnings. The EMS/AHPND disease typically affects shrimp post-larvae within 20–30 days after stocking and frequently causes up to 100% mortality. The causative agent of EMS/AHPND has been reported to be a bacterium, more specifically a pathogenic Vibrio species belonging to the Harveyi clade, presumably Vibrio parahaemolyticus. The effects of EMS were severe and affected most shrimp farms in Belize, with production plummeting to less than half of what it was in 2014.

The effects of EMS were severe and affected most shrimp farms in Belize, with production plummeting to less than half of what it was in 2014. Firm revenues and Belize's corresponding hard currency earnings from shrimp production operations declined considerably from over US$45 million in 2014 to US$28 million in 2015 to less than US$8 million in 2016. [11] During this period employee earnings in the shrimp industry nearly doubled between 2012 and 2014, from US$3.2 million in US$6 million, before dropping to US$1.7 million in 2015. Shrimp industry employment witnessed similar declines with full time employment falling between 2014 and 2015 from 700 to 302 and part time seasonal labor from 750 to 412. [12] And as processing plants are not operating at full capacity and women are primarily employed in the plants, women have been severely impacted.

[10] http://competecaribbean.org/belize/belize-shrimp-growers-achieves-overall-success-with-compete-caribbean/
[11] White Paper on the Shrimp Industry, Development Finance Company. Oct. 2017. 13p
[12] Compete Caribbean Project Completion Report

The shrimp industry is one of southern Belize's most important industries both in terms of income and employment. The contraction the industry experienced as a result of the EMS outbreak was widely felt in neighboring communities that had become significantly reliant on income derived from the industry and the tourism industry was unable to absorb all of the labor force that was laid off during the contraction. Consequently, the local economy remains largely depressed.

Cluster stakeholders interviewed universally recognize the existential threat to their industry disease outbreaks represent. In response to the most recent EMS crisis, Cluster actors have introduced new genetic materials, engaged in certain biological controls and change management practices, and invested in new technologies. To date, there has not been a structured approach to addressing EMS and the recovery effort employed by all Cluster actors. There are no standard operating procedures in place for the appropriate ways to respond to the EMS outbreak and private sector Cluster actors have utilized different approaches to address the EMS outbreak and have different levels of technical capabilities. In addition, information sharing (scientific, outbreak control measures, production etc.) between Cluster actors could be improved in some cases.

1.4.1 The 2015 EMS Outbreak and Key Findings from Preliminary Biosecurity Assessment

Following the EMS outbreak, in general, the present state of the industry is operating well below its full production potential, but it is slowly recovering from the effects of the disease outbreak. Efforts to combat the disease with various production techniques and some biosecurity procedures saw an increase in production and less shrimp mortalities. The BSGA established strategies to overcome this crisis including genetic improvement (brood stock), biological control, changed or enhanced management practices, and investments in new and emerging technologies such as intensive systems, lined ponds with flushing capabilities and the use of probiotics. Adapting and incorporating new technologies for shrimp production in Belize include "Bio-mimicry" utilizing rice-bran, natural microbial probiotics and symbiotics with enzymes solutions; 'semi-intensive' and 'intensive' systems utilizing lined ponds and more aeration devices and extensive systems utilizing low stocking densities, longer growing cycle to get larger shrimp.

New genetic material is currently being tested with success in a few Belizean farms, after working with BAHA for assessing the best potential supplier, and authorizing and controlling the import and movement of broodstock. Additional sources of improved genetic stocks will be tested in the same way within coming years for benchmarking alternative breeding programs and broodstock suppliers.

Other stakeholders, including the Ministry of Agriculture (MOA), Department of the Environment (DoE), the Development Finance Corporation (DFC), the Social Security Board (SSB) and the Belize Agricultural Health Authority (BAHA) have been working along with the industry in the recovery effort with respect to licensing, financing issues,

tissue sampling for disease, importation of brood stock and feed as well as monitoring and quarantine of important animals.

The Project Team recently conducted site visits in Belize to inform a preliminary biosecurity assessment.[13] Key findings from these site visits include:

- High levels of confidence and collaboration exist between farmers including sharing of resources such as staff and laboratory testing, sharing of technical information, shrimp health management data and basic farm management information.
- However, despite various attempts to try new culture methods, systems management and culture techniques, there is a paucity of scientific empirical data and management systems to inform production and disease mitigation decisions.
- The need for better-trained staff on some farms on basic biosecurity systems, hatchery protocols, live food production and water quality management is great.
- A need for a Shrimp Industry Technical Team that can make farms visits, share information, lobby government stakeholders.
- All stakeholders (Government and Private Sector) ascribe to the need for a Biosecurity Zone Management Plan, Research and Development Board, an Innovation Fund and a Disaster Fund. The actual sources of funds are to be better articulated but there was commitment from both sides.
- The possibility of Centralized Laboratory Services to facilitate farms, lower costs and get faster response times for management decision making.
- Need for Collaborative Marketing Initiatives from the Industry despite individual market arrangements and possibilities.
- Workshop Training required in Sustainable Shrimp Farm Practices to include Biosecurity Zone Management Plan, Water Quality Management, Hatchery Protocols, Nutrition and Feeding, Shrimp Diseases and Processing, Record Keeping, Monitoring and Surveillance.

Sound biosecurity practices are good for business since costs may be low compared to the expected benefits. Preventative biosecurity actions that exclude damaging pathogens from entering a country or facility usually provide the best return on investment. It will take continued teamwork and dedication for a continued success in the development of the shrimp industry in Belize and the implementation of the Biosecurity Aquaculture Zone Management Plan will make a huge contribution towards this effort.

[13] Farm visits involved stakeholder interviews and farm site visits to conduct a preliminary baseline biosecurity risk assessment, and to assess the state of the sector. The opportunity was also provided for cluster stakeholder collaboration and interaction to facilitate knowledge sharing and learning and to develop a common participatory approach focused on achieving common objectives. Before each farm or facility tour, discussions were held with the Owners, Managers and Technical Staff on production practices, disease challenges and mitigation efforts.

1.5 Market Analysis

The global trend of aquaculture development gaining importance in total fish supply has remained uninterrupted and will continue to rise with an annual growth of 1.3% to an estimated 181 million tons in 2022[14]. A sizeable and growing share of fish consumed in developed countries consists of imports, owing to steady demand and declining domestic fishery production. In developing countries, fish consumption tends to be based on locally and seasonally available products, with supply driving the fish chain.

Demand for seafood is growing but the domestic wild harvest is insufficient to meet new and increasing demands. Many regional and global competitors have seized this market opportunity and aquaculture has been steadily replacing capture fisheries in supplying many countries with an important source of protein, often affecting local producers, prices and outcomes. [15]

Aquaculture is expected to provide most of the increase in fish production, with the outlook for venturing into and remaining in aquaculture being highly favorable. Fisheries and aquaculture contribute to food supplies, incomes and healthy diets for millions of people all over the world and are particularly important in poverty alleviation, food security, and nutritional well-being of many coastal and rural communities in developing countries[16]. With most capture fisheries worldwide considered fully exploited or overexploited, aquaculture will be central to meeting fish demand, which will continue to increase with population growth, rising incomes and increasing urbanization.[17]

In this context shrimp has become one of the most popular seafood products consumed globally and aquaculture has been steadily replacing capture fisheries in supplying many countries with this important source of protein. Farmed shrimp is one of the fastest growing food commodities with global shrimp production increasing 10% per year since 2000, from 1 million tons to 5 million tons between 2000 and 2015 and currently accounts for 55 percent of the shrimp produced globally. [18] To meet this growing demand, producers in a number of countries, such as China, Indonesia, Vietnam, India, Ecuador and Thailand have entered and developed the market:

[14] FAO 2014. The State of World Fisheries and Aquaculture. FAO, Rome, Italy. 223pp
[15] The State of World Fisheries and Aquaculture. ©FAO, 2016 - I5798EN/2/01.17
[16] FAO 2010. The State of World Fisheries and Aquaculture. FAO, Rome, Italy. 197 pp.
[17] Finegold, C. 2009. The importance of fisheries and aquaculture to development. p. 353-364. In: Wramner, P; Cullberg, M. ; Ackefors, H. (eds.) Fisheries, sustainability and development. The Royal Swedish Academy of Agriculture and Forestry, Stockholm.

[18] California Environmental Associates, "Shrimp Aquaculture Landscape." January 25, 2018 and https://www.worldwildlife.org/industries/farmed-shrimp

Figure 5: Global Shrimp Production – % Growth Compared to Previous Year

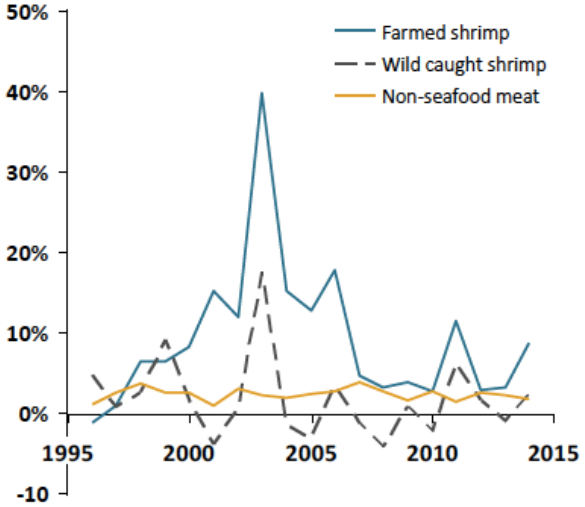
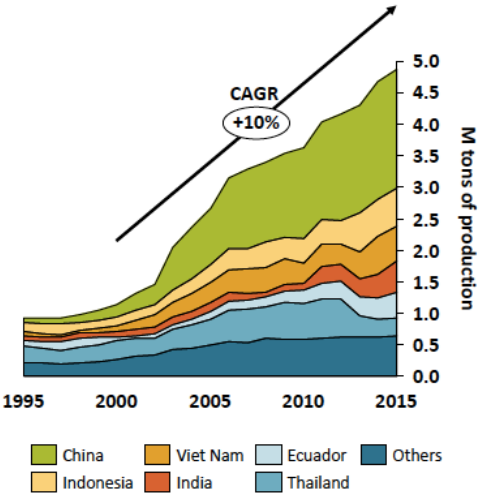


Figure 6: Global Farmed Shrimp Production by Producing Country



Source: California Environmental Associates, "Shrimp Aquaculture Landscape." January 25, 2018

The farmed shrimp sector experienced a major expansion during the early 2000's, followed by a period of decline due to disease outbreaks and sustainability issues.[19] [20]

Similar to other agricultural commodities, historically, shrimp farming has been a high-risk, high-return business pursuit characterized by boom and bust cycles driven by fluctuations in supply/demand equilibrium. The report, "Shrimp Market: Global Industry Analysis (2012-2016) and Opportunity Assessment (2017-2027)", estimates that the current market value for shrimp globally is approximately US$39.1 billion, and will increase to US$67.5 billion by 2027. During this period, the compound annual growth rate (CAGR) for sales revenue is project to be 5.6 percent. [21]

However, periodic disease outbreaks have become a continuing reality of the global shrimp industry, periodically causing major fluctuations in production, prices, income, employment and the fortunes of different regions depending on their relative exposure to the outbreak in question:

[19] https://seafood.no/globalassets/aktuelt/konferansekalender/skalldyr/george-chamberlain----shrimp-situation-nasf-march-9-2017.pdf

[20] "EMS was first found in southern China seven years ago, and it had spread to other parts of Asia in the following years. In 2013, the disease ravaged the Mexican shrimp industry, causing production to drop by about 50 percent." Source: https://www.seafoodsource.com/news/supply-trade/first-ever-detection-of-shrimp-disease-in-us-raises-industry-concerns

[21] https://www.seafoodsource.com/features/asia-pacific-set-to-dominate-global-shrimp-market

Table 2: Sample of Shrimp Diseases and Estimated Monetary Losses		
Disease – Region	**Year of Emergence**	**Estimated Losses (US$)**
YHV – Asia	1991	$0.5 billion
TSV - Americas	1991-1992	$1-2 billion
TSV - Asia	1992	$0.5-1 billion
WSSV - Asia	1992-1993	$6 billion
WSSV – Americas	1999	$1-2 billion
LMNV - Asia	2006	$1 billion
EMS - Asia	2009	$5 billion*

Source: Tess Petesch, Master of Environmental Management "Impacts of disease in shrimp aquaculture on U.S. capture fishery prices." Nicholas School of the Environment, Duke University, 2017

* Thailand only

For example, exports decrease by 70 percent in 2001 due to white spot virus in Ecuador, the Western Hemisphere's largest shrimp producer. [22]

In addition, the Global Aquaculture Alliance asserts that EMS does not affect humans, recently, "six big importers – Australia, South Korea, Saudi Arabia, China, Brazil, and Mexico – have said they will only buy products with disease-free certification in accordance with World Organization for Animal Health regulations, or products recognized as free of diseases by their authorized agencies" [23]

Concurrently, there has been growing concern about the shrimp farming industry's impact on local environments including the physical removal of mangroves and the loss of associated ecosystem services and attributes, to pollution of both surface and groundwater. [24]

As a result, new higher-value markets have emerged that pay a premium for higher quality products such as wild or sustainably certified farmed shrimp (such as ASC-certified shrimp). Total global demand for ASC-labeled of Whiteleg Shrimp (vannamei) grew from less than 200 metric tons in 2014 to nearly 23,000 metric tons in 2017:

[22] https://thefishsite.com/articles/how-can-we-save-the-global-shrimp-industry-from-devastating-diseases

[23] https://www.seafoodsource.com/news/supply-trade/first-ever-detection-of-shrimp-disease-in-us-raises-industry-concerns and https://www.seafoodsource.com/features/vietnamese-shrimp-producers-in-danger-of-losing-export-markets

[24] See for example: http://mangroveactionproject.org/shrimp-farming/

Table 3: Volume of ASC-labeled of Whiteleg Shrimp (vannamei) in Demand in Several Key Markets and Total Global Volume – 2014-2017 (Metric Tons)				
	2014	**2015**	**2016**	**2017**
Belgium	5.6	101.65	1,580.18	2,484.30
Canada	0	264.93	404.53	550.02
Denmark	54.49	426.89	518.52	1,086.71
Germany	52.66	657.85	3,183.67	4,868.72
Netherlands	0	147.22	982.07	2,173.20
Norway	0	194.75	713.81	916.77
United Kingdom	0	0	15.54	736.24
United States	0	95.90	46.43	122.76
Total Global	199.57	3,750.59	14,080.34	22,984.67

Source: Aquaculture Stewardship Council

Market demand for ASC-certified shrimp has been especially strong in Northern European countries such as Germany, Belgium and the Netherlands. However, demand is also expected to grow in Canada, the United States and the United Kingdom where Belize enjoys an advantage because of its relative proximity to those markets:

Still, to date, only 20% of shrimp producers in the world have complied with demanding sustainable production certification standards [25] and in fact, sustainable production certifications only cover a small portion of global shrimp production:

Table 4: Sustainable Certification Status in Key Producing Countries		
Country	**Tons of Production (2015)**	**Certification Status (by % of volume)**
China	1,892,801	0%
Indonesia	595,071	6%
Vietnam	550,240	21%
India	500,758	12%
Ecuador	403,000	12%
Thailand	294,896	4%

Source: California Environmental Associates, "Shrimp Aquaculture Landscape." January 25, 2018

This relatively low level of sustainable production certifications is not surprising as producers in many shrimp-growing regions struggle to comply with ASC and other sustainable certification programs' strict compliance requirements, making ASC certifications even more valuable. [26]

[25] http://competecaribbean.org/belize/belize-shrimp-growers-achieves-overall-success-with-compete-caribbean/

[26] For example, "ASC certification imposes strict requirements based on the core principles of the International Labour Organisation (ILO), these include prohibiting the use of child labour or any form of forced labour. All ASC certified farms are safe and equitable working environments where employees earn a decent wage and have regulated working hours. Certified farms need to consult and engage with local communities to ensure they provide access to vital resources and deal with complaints or conflicts in a proper manner." Source: https://www.asc-aqua.org/what-we-do/our-standards/farm-standards/the-shrimp-standard/

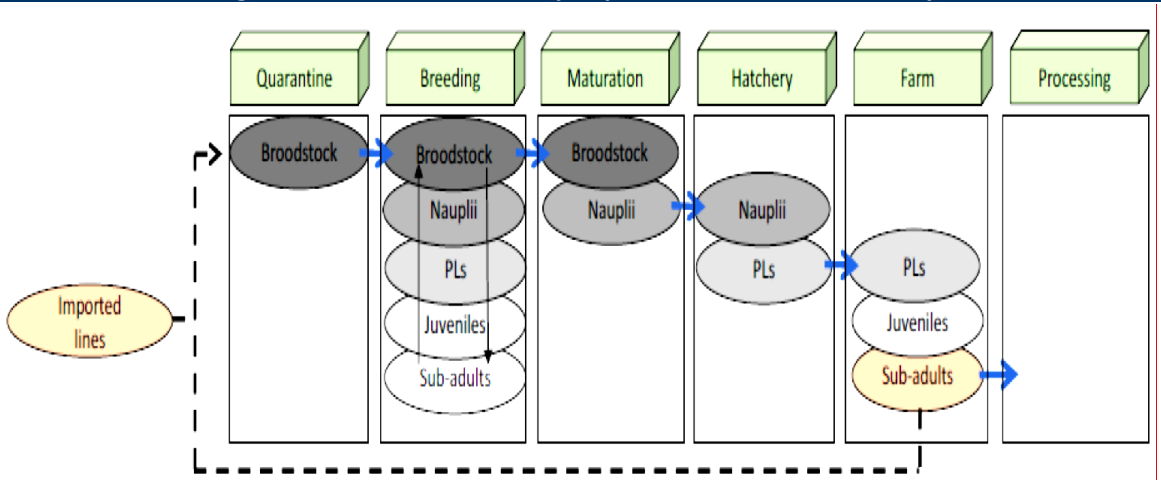
As such, there is a first mover advantage opportunity for producers that can certify their production systems to gain access to these growing premium, sustainably-certified markets. Ecuador is one such country that is endeavoring to maximize this opportunity. Leading Ecuadorian farmed shrimp producers recently established the Sustainable Shrimp Partnership that aims to improve the Ecuador's reputation as a source of sustainably produced shrimp.[27]

These trends and figures suggest that the premium market targeted by Belizean producers keeps expanding as the demand of consumers for quality, sustainably-produced food increases.

1.6 Value Chain Process Map

From a biosecurity perspective, a thorough understanding of the shrimp aquaculture value chain is critically important as it aids in understanding how and where critical points in the production process can present or permit biosecurity breaches. A very general and abbreviated value chain map that broadly illustrates the process and steps from production to global markets and the relationship between inputs, production, processing, export is included in the diagram below:

Figure 7: Abbreviated Shrimp Aquaculture Value Chain Map



Source: Francois Brenta, "Biosecurity in Shrimp Farming – Practical Biosecurity Risk Management Measures." XIX Congreso Ecuatoriano de Acuicultura

In general, processors within the value chain negotiate volume, shrimp size and price with wholesale and retail actors while wholesale and retail actors strive to balance access to consistent supply with an increasing demand for sustainability from niche markets. Over the last few years, Belizean farmed shrimp have been exported to Mexico for further processing or to Europe, Asia, the Caribbean and North America for retail markets.

[27] https://www.seafoodsource.com/seafood-expo-north-america-2018/with-an-eye-on-india-ecuador-launches-sustainable-shrimp-partnership

Profitability at the farm level is mostly determined by production volume, which has been drastically reduced by disease. As such high quality inputs are required to provide the highest probability of high survival rates in disease-prone environments. Some of these key inputs include: [28]

- Quality feed;
- Broodstock (genetic material) that is appropriate for the specific conditions; [29]
- Management practices to decrease pathogens in ponds; and,
- Technology, education and training (aeration, water treatment waste management, nursery management, feed regimes etc.).

In terms of understanding where and how biosecurity breaches could occur along the value chain, risk mitigation generally fall into three broad categories: [30]

1. **Biosecurity governance and enabling environment risk mitigation:** policies and regulations such as broodstock quarantine policies, regulations and environmental and standards compliance enforcement
2. **Value chain risk mitigation:** risks in areas of the value chain such as broodstock or feed suppliers, ground and sea transportation to/from farms etc.
3. **Production facility risk mitigation:** breeding programs and standard operating procedures at hatcheries, nurseries, ponds and processing plants.

The diagram below graphically illustrates some of the key pathways of disease entry and expansion:

[28] California Environmental Associates, "Shrimp Aquaculture Landscape." January 25, 2018

[29] "Pathogen-resistant (SPR) post larvae reared in remote and disease-free environments like Hawaii have become the broodstock of choice for most operations around the world." Source: California Environmental Associates, "Shrimp Aquaculture Landscape." January 25, 2018

[30] Melba B. Reantaso, "FAO Efforts on Shrimp Aquaculture Health Management Including the AHPND International Technical Seminar." Food and Agriculture Organisation of United Nations, FAO TCP/INT/3502, July 24, 2012

Figure 8: Key Risk Pathways for Pests and Diseases to Spread on to, within and from a Farm

Source: Omar Elhassan, "Available Information on Biosecurity and Prudent Use-Related BMPs in Aquaculture." Food and Agriculture Organization of the United Nations, FMM/RAS/298

As such, identifying specific areas of existing or potential disease hazard and applying appropriate biosecurity mitigation measures is critically important. And from the Project Team's recent site visits to Belize, several critical points of biosecurity risk in Belize's shrimp value were preliminarily identified including:

- Sources of imports broodstock, feed and rice bran, (although BAHA conducts checks at the source);
- Husbandry practices related to handling, feeding, and stocking, and water and pump treatment;
- Disposal of pond water after a mortality event, and the farm's water source (which may be connected to other shrimp or tilapia farms, or be open to the sea);
- Climate change, which increases water temperatures and therefore the salinity of the ponds;
- Birds can spread pathogens from one pond to another or from farm to farm;
- Sharing of equipment across farms and other contact points between farms e.g. via vehicles; and,

- Contact with buyers (their personnel/vehicles) when product is sold at the border and/or other ground or sea transportation providers.

1.7 SWOT Analysis

The following Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis of the current status of the Belize Shrimp Cluster shed light on the internal and external environment affecting sustainable shrimp aquaculture production in general provided useful information for matching the country's resources and capabilities to the competitive environment of which it is a part:

Table 5: SWOT Analysis of Shrimp Cluster

Strengths	Weaknesses
• Favorable conditions for shrimp aquaculture • Belizean shrimp selling on premium markets with more stable and higher prices on average than commodity markets. • Strong industry leadership and solid core of experienced producers • Generally cohesive group cooperation • Certified under the Aquaculture Stewardship Council • Advanced technical know-how of some producers • Small size of the industry in number of facilities and geographical extension makes monitoring less complicated • Good relationships with local communities • Good relationship with governmental agencies • Willingness to adopt collective measures for disease management • The BSGA has already worked with Compete Caribbean and WWF to achieve the certification of >90% of the industry against ASC.	• Minimum investment in human resources capacity building • Lack of proper biosecurity measures • Temperature drop risks during winter • Education and training for technical workers • Limited availability of skilled workers • Lack of experts in aquatic animal health • Limited technical capacity of some producers • Limited investment capacity • Limited access to financial • Knowledge and technical capacity limitations are major impediments to widespread adoption of both, appropriate biosecurity measures and production techniques.
Opportunities	**Threats**
• Demand for responsible shrimp (as ASC certified in particular) is increasing on North American, European and also Asian markets • Continued growth in consumer demand for shrimp in major world markets • Improved image of Belizean shrimp with importers and retailers • Capitalize on increasing buyer and consumer demand for good practice certification • Increasing support and interest in shrimp industry from Belize Government • Relationships with international institutions with expertise in aquatic animal diseases • Development of national expertise in shrimp health through knowledge transfer from international experts in capacity building programs. • Improved predictability of production systems and sustainability of the shrimp farming industry	• Diseases outbreaks (e.g. EMS & white spot) • Hurricanes and, more generally, natural disasters associated to climate change, including increases in ambient temperatures • Lack of funds to implement biosecurity measures • One misstep by any one player will strongly impact on all. • Export markets taken by competitors while production is low. • Lack of funds to adapt production facilities and adopt new technologies • Potential import restrictions in key export markets[31]

[31] For instance in 2017 the European Union (EU) considered measures against perceived health risks of Indian shrimp imports, including an outright ban. See: https://www.undercurrentnews.com/2017/10/27/gulkin-shrimp-industry-fears-domino-effect-from-possible-eu-india-ban/

Per the critical issues highlighted above, there are several important takeaways from the SWOT analysis. Some of the Cluster's strengths are advantages that can continue to be leveraged in the marketplace. These include ASC certification existing presence in premium markets, strong industry leadership and willingness to adopt collective measures for disease management.

The weaknesses are internal to the Cluster and thus are issues that Cluster actors have the capacity to address. However, they cannot all possibly be addressed in the context of this proposed CDP. However, this CDP does aim to address many of the weaknesses identified.

1.8.1 Porter's Diamond and 5 Forces Analysis

Taking the results of the SWOT analysis into account, Porter's 5 Forces Analysis[32] further helps to reveal the key issues that must be considered to inform the design of the most appropriate strategy for the Cluster

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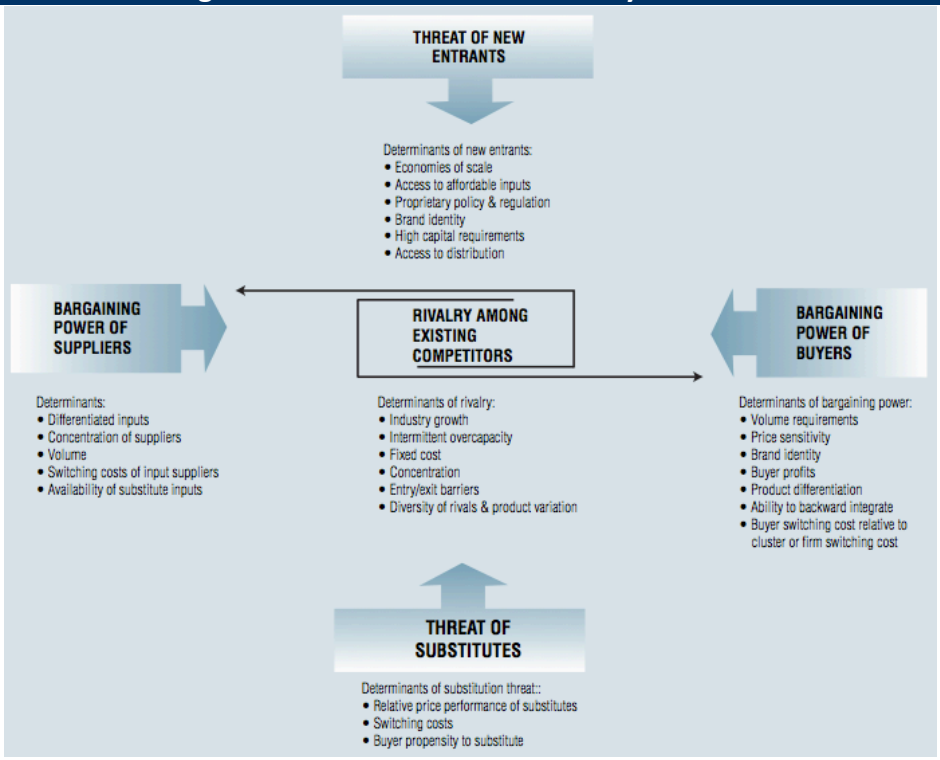
Figure 9: Porter's Five Forces Analytical Tool



Source: Mallika Shakya, "Clusters For Competitiveness: A Practical Guide & Policy Implications for Developing Cluster Initiatives," - International Trade Department of the World Bank, February 2009.

[32] "[Porter Five Forces analysis] is based on the concept that there are five forces that determine the competitive intensity and attractiveness of a market. Porter's five forces help to identify where power lies in a business situation. This is useful both in understanding the strength of an organization's current competitive position, and the strength of a position that an organization may look to move into." Source: https://www.cgma.org/resources/tools/essential-tools/porters-five-forces.html

Rivalry among existing competitors

Rivalry among existing competitors is low to moderate both within the Belizean shrimp industry and the larger global sustainably produced shrimp industry. Within the Belizean shrimp industry, although a healthy rivalry exists between different shrimp producers, industry actors often collaborate on a number of collective issues including pooling production volumes to meet customer requirements. In regards to the global sustainably produced shrimp industry, by default products are already highly differentiated from commodity products and further, there are relatively few actors producing certified sustainably produced shrimp.

That said, like the Belizean industry, some competing shrimp producing regions like Ecuador are actively working to certify their production systems to firmly entrench positions in growing, premium, sustainably certified markets and enhance Ecuador's reputation as a source of sustainably produced shrimp.

Threat of new entrants

The threat of new entrants is moderate to low. It is relatively difficult for new entrants to enter the certified sustainably produced shrimp market. For instance, some level of economies of scale is required, either within one individual firm, or by pooling production from separate firms, to meet buyers' volume requirements. Further, certified sustainably produced shrimp industries are characterized by relatively complex production systems that are driven by science and access to and incorporation of relevant technologies making relevant scientific expertise a requisite. These technical requirements in turn lead to relatively high capital requirements and in many cases it is difficult for competitor shrimp-growing regions to comply with ASC and other sustainable certification programs' strict environmental and social compliance requirements.

These represent effective barriers to entry for incumbents and restrict the number of potential new entrants that would naturally be attracted to these highly profitable niche premium markets.

Threat of substitutes

The threat of substitutes is low. Although close substitute products do exist that are also important sources of protein such as chicken or soy products, the likelihood of customers switching to alternatives in response to price increases remains low. Global demand for commodity shrimp is forecast to grow, as is demand for sustainably produced shrimp diminishing the threat of substitutes.

Bargaining power of buyers

The bargaining power of buyers is moderate. On one hand, because the number of buyers of sustainably produced shrimp remains relatively small, these few buyers can often dictate terms and prices on suppliers. However, there is currently more demand for sustainably produced shrimp than there is supply and through consistently meeting strict ASC requirements shrimp producers can establish levels of trust with buyers making it more difficult to switch from one shrimp producer to another.

Bargaining power of suppliers

The bargaining power of suppliers is moderate to high. Particularly in a post-EMS outbreak environment, shrimp producers have become increasingly reliant on a small set of specialized broodstock and feed suppliers. Specific broodstock and feed varieties are proving to be especially well suited to Belize's production conditions and thus, the number of suppliers of these essential inputs is small and the cost of moving from one supplier to another can be prohibitive. Consequently, the bargaining power of suppliers of essential inputs has grown as the industry recovers from the EMS outbreak.

In sum, the global shrimp commodity market is a crowded, competitive marketplace requiring significant economies of scale to compete effectively. Belize's relatively small shrimp industry does not have a strong competitive position to compete in the global shrimp commodity market and cannot compete, in the long term, in the "price-based" commodity segment.

However, the Belizean shrimp industry has proven that it can compete quite well when granted privileged access to high-quality niche markets via ASC certification. As long as forecasts for increased demand for sustainably produced shrimp hold true and it remains difficult for many competitor shrimp-growing regions to comply with ASC and other sustainable certification programs' strict compliance requirements, the attractiveness of the niche, premium market and opportunities for high profit margins, will remain high, while the competitive intensity will remain relatively low.

These factors help underscore the strength of the Cluster's existing competitive position as long as it maintains its current trajectory and can put in place appropriate biosecurity measures and thus better ensure consistent production levels that can reliably meet customer volume requirements.

II. Growth and Competitiveness Strategy

2.1 Vision

The overarching vision for this project is to put the necessary biosecurity infrastructure and capabilities in place that will enable Belize's shrimp industry to maintain and sustain its international competitiveness in premium ASC-certified export markets, thereby continuing to be an important component of Belize's economy in terms of foreign exchange, contribution to GDP and rural employment characterized by good labor practices and conditions as required by ASC.

This vision can be realized by improving the performance predictability of shrimp production through strengthened biosecurity to reduce disease risks and impacts. This will create a critical mass of production that will permit the Cluster to leverage this successful niche market development approach, attain 2014 performance levels, and eventually surpass pre EMS-outbreak production, sales, exports and employment levels.

As such, specific commercial and socioeconomic goals that this project aims to achieve by September 2020 include:

- Improved predictability of shrimp production recovering to at least 2014 production levels;
- Annual sales of US$50 million;
- Achieving 25% of national exports into premium markets;
- Achieving a 25% mark-up above commodity market prices;
- Increased premium seafood market access in Europe and North America; and,
- Create 1,000 additional job opportunities for rural communities in Southern Belize.

In parallel, as commercial and socioeconomic goals are integrally tied to improved biosecurity conditions, specific biosecurity-related goals that this project aims to achieve by September 2020 include:

- Creation of a functioning Biosecurity Aquaculture Zone Management Plan (BAZMP) that standardizes production and biosecurity practices and has clear response measures;
- Functioning standardized and systematic surveillance and monitoring data collection system in place;
- Functioning early warning system for data collection and epidemiological data analysis in place;

- Trained technical staff that are accessible to all farms with in-house capacities to better monitor shrimp diseases and improve early responses to diseases.. Initially, at least one technical staff per farm is targeted; and,
- New biosecurity standards and regulations in place and enforced to regulate sustainable and competitive shrimp production in Belize.

2.2 Analysis of Strategic Options

This project is building on the experience of the previous Compete Caribbean project. The initial commercial successes through 2014 that the Belize Shrimp Cluster realized via ASC certification and the resulting access to premium, niche export markets confirmed the demand for ASC-certified shrimp and the strong potential of Belize as a preferred supplier, establishing the business rationale for the Cluster's market development approach.

However, Cluster actors universally agree that up unti 2015, they placed too much focus on commerical and market issues and thus, did not have the appropriate systems in place to manage the EMS outbreak. Through the recovery process, there is now widespread acknowledgement amongst Cluster actors that when it comes to biosecurity issues, the Cluster is only as strong as its weakest link. Cluster actors assert that investment decisions within the industry cannot continue to be based on anecdotes, but rather need to be evidence-based and data-driven by scientific findings. As such, there is a willingness to adopt collective measures for disease management and heightened optimism that this Project could bring the type of Belize-centric science to the shrimp industry that will allow for evidence-based investment decisions, industry practices and standards.

In addition, restoring the confidence of lenders and investors in the Cluster's production systems will be essential to taking advantage of these market opportunities. It is anticipated that a functioning standardized and systematic surveillance and monitoring data collection system that captures each farm's production methodology and corresponding yields, shrimp health and water quality, to allow for evidence-based decision-making on optimal production methods will help to instill confidence in lenders and investors.

The hypothesis put forward here is that going forward, employing this evidence-based strategic approach driven by aquaculture best management practices and scientific findings will better position the Cluster to continue to maximise premium, niche export market opportunities afforded by ASC certification.

2.2.1 Aquaculture Best Management Practices

All aquaculture farms must operate with an aquaculture code of practice that will not be damaging to the environment and farm aquatic animals in a sustainable manner and wise-use of the natural resources and employ mitigation activities in all start-up activities, construction and operational phases. To be incorporated into all farms' aquaculture code of practice are the principles of the following documents:

- Code of practice for fish and fishery products[33] with specific focus Sections 6, 7 and 14.
- Code of conduct for responsible fisheries[34] with specific focus on Article 9: Aquaculture.
- Manual of Diagnostic Test for Aquatic Animals[35]
- Belize Biosecurity Zone Management Plan.

Mitigation Activities

Mitigation activities will include:

- **Emphasis on disease prevention**: good husbandry, feed quality, site and water quality, water management, water supply and discharge design and infrastructure. Tank and water quality managemen**t**, water supply infrastructure, recirculating systems and measures to prevent pathogens to enter the farm, starting at the farm gate, for instance the disinfection of vehicles, personnel and not allowing load trucks enter into farm production areas.
- **Due diligence for all importation of broodstock shrimp**.
- **Reducing dependence on chemicals** through disease prevention.
- **Develop hatchery** production of nauplii, and post-larvae where applicable.
- **Records** of feed, fertilizer, water exchange, stocking rates, and harvest weights should be properly maintained**.**
- **Better husbandry,** better quality water management, better quality feed, and better-quality seed will all reduce the likelihood of disease and the need for and use of chemicals.
- **Shift f**rom high exchange systems to more closed-looped systems where minimal water exchange takes place in the production ponds, and water quality is maintained using intensive aeration and manipulation.
- **Utilize phased grow-out systems** by using nursery stage for post larval growout before stocking
- **Farm laboratories** for pathology and bacteriology

[33] FAO. 2012. Code of Practice for Fish and Fishery Products, Second Edition. World Health Organization. Rome. 250 pgs.
[34] FAO. 1995. Code of Conduct for Responsible Fisheries. Rome. 41 pgs.
[35] OIE. 2003. Manual of Diagnostic Test for Aquatic Animals, Fourth Edition. Paris. 358 pgs.

- Support a strong **surveillance program**

Research and Development

The importance of Research and Development should lead to business outcomes, the recruitment and retention of key industry professionals that will develop working processes and know-how thereby terminating the present practice of farm trials based on anecdotal reports without scientific rigour. The creation of intellectual property for the BSGA, may give competitive advantage in the world market. The value of strategic investment by Government institutions such as DOE, BAHA, MOE in research and industry creation and the collaboration between aquaculture stakeholders, both in the public and private sectors, have shown that there is a commitment to promoting safe and sustainable aquaculture businesses.

This activity must engage, inform, educate, and empower the supply chain to work together to assess all the inputs necessary to determine if they can be improved and/or produced locally solve collective farming issues that not only impact local lives and livelihoods, but also may have negative impacts on continuity of supply, as well as perceived and real quality concerns in the marketplace. In addition, research and development activities should provide information to financial institutions such as the DFC and industry players such as BAHA, DOE, to understand the industry investment requirements, the risks and returns.

Quality Assurance

Quality assurance has been identified as one most important aspects for improvement in the seafood value chain. BAHA and BSGA can play a major role in the quality assurance of seafood and improve focus to satisfy consumer requirements and preferences. Since over 50 per cent of the seafood traded in international markets comes from aquaculture, it is important to ensure that the aquaculture sector is producing safe food. An emphasis on regulation and control of the food safety system with preventive measures to control the introduction of contamination at source requires the adoption of practices in food production, handling and processing that reduce the risk of microbiological, chemical and physical hazards entering the food chain.[36]

Marketing

Sometimes, supplementing or replacing existing capture fishery products, developing new market opportunities through improved availability, novel products and/or

[36] Understanding and applying risk analysis in aquaculture: a manual for decision-makers. 2009. FAO Fisheries and Aquaculture Technical Paper 519/1. Rome, FAO. 113 p.

improved market chain efficiency.[37] Recent developments with tank-raised shrimp and intensive systems suggest that immense potential exists if a quality, fresh and wholesome product is offered. [38]. There is also an opportunity to employ social marketing to differentiate the Belizean shrimp industry, comparing Belize's comparatively good labor practices with poor labor practices that are often practiced in several other shrimp-producing regions in the world.

Education

Education plays a huge role for industry personnel in an increasingly knowledge-based activity as well as to inform consumers and end-users in appropriate utilization of seafood products and maintaining quality throughout the seafood value-chain. The local University of Belize should be encouraged to be more involved in the shrimp industry as well as continued links with foreign universities. Collaborative mechanisms should be developed between industry and University of Belize to identify specific projects, design curriculum, appropriate R&D focus, etc.

Training and Extension

While agriculture extension services are clearly defined for various crops, there is no specific setup for shrimp farming extensions agents, although there is input from BAHA. These agents require Aquaculture Extension training and experience before actual interaction with local and potential farmers. Serious attention must be given to extension services to farmers to fast-track success rates and mitigate crop failures and repeated mistakes. The likelihood of the BSGA initiating this effort along with Government entities is a distinct possibility. Dedicated teams for specific issues such as water quality management, disease identification, shrimp health management, production and marketing of products must support the industry with clearly planned and articulated protocols amongst agencies. The major task will involve collecting and packaging information and convincing entrants about better technology and refining existing systems towards successful businesses.

Shrimp Health Management

Existing regulatory protocols in Belize and routine farm management systems do not strictly enforce the practice of sound aquatic animal health as well as related biosecurity measures. Prevention of disease entry, early disease recognition and proper chemical and drug usage are also integral to good practices and farm sustainability. There is currently, however, insufficient capacity and knowledge among farmers and staff in Belize as to how to effectively incorporate good management practices into an effective aquaculture farm health management programme. This represents a critical gap that threatens the growth and sustainability of the local shrimp industry and is potentially a further threat to marine fish stocks.

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[37] Green grow the fishes-oh? Environmental attributes in marketing aquaculture products. 1999. James A. Young, Cecile Brugere & James F. Muir. Aquaculture Economics & Management Vol. 3, Iss. 1.

[38] Marketing of the farmed shrimp *Litopenaeus vannamei*: a pilot survey of restaurants in Trinidad. 2016. Edmond, R. SIDC Final Report. 10p.

2.3 Strategic Direction

To improve the predictability of production systems and the performance of shrimp farms and begin to take advantage of premium niche market opportunities again, the control of diseases is going to be the main challenge for the Cluster. Creating standards and consistency amongst Cluster actors will be key towards the Cluster's ability to both, recover from this EMS outbreak and to mitigate risks associated with potential future disease outbreaks.

For the shrimp industry to overcome the slow pace of increased production and the critical biosecurity challenges faced in Belize, significant changes in approach are required. This requires a new phase of implementation with the collaboration of both public sector and private sector stakeholders to fund the management of innovative research and development efforts, properly document all aspects of the shrimp industry and institute a legislative framework for eventual mandatory compliance. This is a huge opportunity for sustainable businesses that can make excellent returns and penetrate new markets, while ensuring inclusive and sustainable development. Aquaculture production systems must be geared to produce high-quality freshwater products and marine seafood that are:

- Sustainably produced in an environmentally-friendly, disease-controlled, contaminant-free and bio-secure operation.
- Use fair labor practices free of human rights abuse.
- Sold fresh or processed into value-added products that will achieve broad market acceptance and effective demand in local and export markets.
- Delivered regularly, year-round at competitive prices.
- Used as model facilities for sustainable marine shrimp production to provide technical knowledge to stakeholders and offer training on sustainable shrimp production systems.

As such, the Belize Shrimp Industry needs a cohesive and consistent effort from all the interested parties both in the public and private sectors involved. Growth can be promoted by the following:

- Decide on the **appropriate technologies**, **best management systems** and **fine-tune for lower**

- Leadership and a driver for the industry BAZMP.
- Effective collaboration between government, state agencies, industry, and farmers.
- Accelerating innovation and production.
- Harnessing available skills.
- Public-sector private partnerships (PPP).
- Appropriate marketing initiatives.
- Scaling-up of innovative operations from science-based farm trials.
- Establish fund for research and development and emergencies

production costs.

- **Knowing the economics** of setting up **farm biosecurity systems** and involve owners, farmers, and staff in implementation.
- **Termination of importation of shrimp and shrimp products** leading to improved quality in the local value chain and food security and general industry biosecurity.
- **Earning foreign exchange** from eventual export of aquaculture products from more diverse markets.
- Introduction of **new aqua-businesses** and sustainable livelihoods and more aquaculture production systems to meet exploding consumer demand for seafood.
- **Engage new and existing stakeholders** in aquaculture, not only shrimp farmers as they may also adversely affect biosecurity efforts.

The Cluster's strategy aims to develop the internal capacities and infrastructure to overcome the challenge of controlling the spread and impact of diseases by collaboratively upgrading pathogen controls within the country and developing technical expertise within the Cluster on advanced production methods and the monitoring of production systems.

2.4 Integration with Academic and/or Training Institutions

It has been reported that currently, the University of Belize does not have the requisite scientific expertise in house to effectively assist the Cluster with the recovery from this EMS outbreak and to mitigate risks associated with potential future disease outbreaks.

The Project proposes to hire a consulting team from a renowned international academic institution to provide services to improve the Cluster's internal biosecurity capabilities and infrastructure. In addition, it is envisioned that during this Project the Cluster will develop enhance R&D capabilities with laboratory facilities and test hatcheries and ponds, possibly in partnership with the University of Belize, to inform production practices and build local capacity.

Thus, it has been suggested that the University of Belize be involved in specific Project activities where that institution's scientific capacities could be enhanced to better positions to effectively assist the Cluster with the recovery from this EMS outbreak and to mitigate risks associated with potential future disease outbreaks. For example, select University of Belize staff members have been building capacity in fresh water and marine pollution research and monitoring.[39] It is anticipated that select University of

[39] https://www.ub.edu.bz/ub-continues-to-build-capacity-in-fresh-water-and-marine-pollution-research-and-monitoring/

Belize staff will primarily be involved in the activity to intensify and improve the pathogens surveillance and monitoring in Belize's shrimp production zone, onsite pathogen monitoring activities and promoting conferences in shrimp production best management practices.

III. Implementation

3.1 Cluster Initiative – Project Purpose

The purpose of the CDP is to provide a roadmap for the creation and implementation of a Biosecurity Aquaculture Zone Management Plan (BAZMP) among Belizean shrimp growers. It is anticipated that implementing the BAZMP will create conditions to improve the performance predictability of shrimp production through strengthened biosecurity to reduce disease risks and impacts creating a critical mass of production, permitting the Cluster to realize and potentially surpass, the commercial and regional development successes the Cluster realized prior to the EMS outbreak.

It is anticipated that this type of investment in the Cluster's biosecurity infrastructure and capabilities will be key to remaining competitive globally, permitting the Cluster to both, manage potential future disease breaks more effectively while also providing a solid foundation for strong market positioning and growth.

3.2 Specific Project Objectives

With the Belize Shrimp Biosecurity Aquaculture Zone Management (Project) the Belize Shrimp Cluster (Cluster) aims to improve shrimp production and support farm rehabilitation over a project time frame of 2 years to bring Belizean total sales back to the 2014 level of about US$50 million by December 2020 and create up to 1,000 additional jobs for workers from surrounding rural communities in southern Belize.

To achieve these goals, the Project proposes to develop and implement a Biosecurity Aquaculture Zone Management Plan (BAZMP) among Belizean shrimp growers that standardizes production and biosecurity practices and has clear response measures to improve the performance predictability of shrimp production. The Project will identify biosecurity risks in shrimp production facilities conducting biosecurity risk assessments based on management practices and biosecurity hazard identification. Once the risks are identified, the BAZMP will be developed, adapted to Belize shrimp production biosecurity needs, to improve pathogen diagnostic capacity at the farm-level in collaboration with BAHA.

The transfer of knowledge gained through the project on pathogen monitoring and management practices will strengthen the technical capacity of aquaculture practitioners. This project will contribute to upgrading and expanding the capacity of testing and diagnostic laboratories in the country and building the capacity of select University of Belize staff, as well as, validating that new genetic material and production systems allow for a greater control of pathogens, lower impact of diseases and as a result a greater predictability of production performance.

The proposed Project has three primary objectives:

1. **Adopt and enforce mandatory regulations for biosecurity:** The industry will define and agree on requirements that will be first adopted voluntarily but with the vision that they will become mandatory regulations that will be enforced.
2. **Enhanced monitoring and data analysis capabilities**: Establish and improve surveillance programs of shrimp health and production information (water quality, pond management etc.), and develop capacity for epidemiological analysis of data.
3. **Capacity building**: Develop new knowledge and technology on best production methods for preventing disease, and transfer to participants through training and information sharing.

As a result of the Project it is expected that the Belizean shrimp industry will get back to total 2014 sales levels of US$50 million USD and create up to 1,000 jobs within the next 2 years. Also, Belize will be the first country in the world to develop and implement Biosecurity Aquaculture Zone Management Plan (BAZMP) covering an entire country, to ensure the sustainability and competitiveness of the sector in international markets demanding responsibly produced seafood.

3.2.1 Suggested Framework for Biosecurity Aquaculture Zone Management Plan

Based on the Project Team's site visits, it is advised that the BAZMP incorporates the following approach and also includes the following key elements:

Transboundary movements

Transboundary movements of viral and bacterial pathogens are a major problem in shrimp farming worldwide. Three categories of infectious diseases affecting aquaculture include: [40]

1. Exotic diseases that are important to trade (i.e. OIE list of diseases); they are governed by international standards; a set of criteria needs to be met to be included in the list; and they are pathogens/diseases of important traded species (e.g. finfish, crustaceans, mollusks, amphibians); reporting/notification to OIE is recommended during an outbreak

[40] Development of a Progressive Management Pathway to assist national and international improvement of biosecurity in aquaculture production. (Draft Working Document). K. Sumption, M. Reantaso, M. Lawrence et al. presented during the Stakeholder Consultation on PMP for Improving Aquaculture Biosecurity, 10-12 April 2018, Washington DC, USA. 20p.

2. Endemic diseases that consistently affect aquaculture production at hatchery, nursery, and grow-out facilities caused by bacteria, parasites, fungal, virus
3. Newly emerging diseases (which include diseases of known aetiology that are introduced to new geographical areas or new species and diseases of unknown aetiology).

Crustaceans such as crabs, lobsters, crayfish, shrimp, krill, and barnacles may carry low levels of one or more non-host specific viral pathogens, even lethal ones, as persistent infections for long periods without gross signs of disease[41]. If a secure supply of uninfected brood stock to produce post-larvae for stocking of shrimp ponds, the next biggest problem for farmers is to maintain strict biosecurity at the farm level to prevent transmission from natural carriers to shrimp in rearing ponds, mostly by exclusion of potential shrimp and other crustacean carriers during pond preparation before stocking and during rearing after stocking. Once a pathogen is introduced or becomes established in the natural aquatic environment, it becomes more difficult for either treatment or eradication. Also, importation of shrimp and shrimp products is also a potential hazard. The use of squid, polychaete and blood worms for brood stock maturation must be carefully monitored and managed.

Biosecurity Plan

Biosecurity is defined as the practice of exclusion of specific pathogens from cultured aquatic stocks in broodstock facilities, hatcheries, and farms, or from entire regions or countries for the purpose of disease prevention[42] . A biosecurity plan template will be designed to provide a framework for the development of the Biosecurity Zone Management Plan. It is recommended that professional biosecurity advice will be utilized to document and provide a detailed assessment of the risks associated with specific countrywide and farming operations and in the development and implementation of the final biosecurity plan.

The draft biosecurity zone management plan will have the following elements:

- Identification of Disease Hazards and Risks
- Identification of Critical Control Points for Disease Entry or Escape
- Establishing Mitigating Actions for All Critical Control Points

[41] Improving biosecurity: a necessity for aquaculture sustainability. Hine, M., Adams, S., Arthur, J.R., Bartley, D., Bondad-Reantaso, et al. 2012. In Farming the Waters for People and Food. Proceedings of the Global Conference on Aquaculture 2010, Phuket, Thailand. 22–25 September 2010. pp. 437–494. FAO, Rome and NACA, Bangkok.

[42] Biosecurity in Aquaculture Production Systems: Exclusion of Pathogens and Other Undesirables. Lee, C.-S. and O'Bryen. P. J. Editors. 2003. The World Aquaculture Society$_5$ Baton Rouge LA USA pp. 81–116.

- Determination of Existing Disease Status or Freedom from Disease
- Develop Contingency Plans
- Monitor Progress and Audit Implementation
- Certification of Biosecurity Levels or Disease Freedom
- Documenting the Biosecurity Zone Management Plan.

A. **Identification of Disease Hazards and Risks**

Decide what diseases are serious or potential threats. All possible disease hazards including OIE-Listed diseases, infections and infestations in force in 2018 - Crustacean diseases. These include but are not limited to:

- ✓ Acute hepatopancreatic necrosis disease
- ✓ Infection with *Aphanomyces astaci* (crayfish plague)
- ✓ Infection with *Hepatobacter penaei* (necrotising hepatopancreatitis)
- ✓ Infection with infectious hypodermal and haematopoietic necrosis virus
- ✓ Infection with infectious myonecrosis virus
- ✓ Infection with *Macrobrachium rosenbergii* nodavirus (white tail disease)
- ✓ Infection with Taura syndrome virus
- ✓ Infection with white spot syndrome virus
- ✓ Infection with yellow head virus genotype 1
- ✓

B. **Identification of Critical Control Points for Disease Entry or Escape**

This includes keeping detailed information on location of animals on farms, any transfers or movements, aquatic animal production, enhancement programmes and processing facilities.

- ✓ Preliminary Producer/Operation Biosecurity Questionnaire
- ✓ Disease Hazards and Risk Assessment
- ✓ Critical Control Points
    - Critical Control Point Step 1 -Description of the Activity (broodstock, PLs, juvenile, grow-out; biology, disease, husbandry Species/production type (e.g. ponds, intensive systems, shrimp harvesting and processing.
    - Critical Control Point Step 2 – Identify Potential Disease Hazards Identify infectious diseases that are hazardous to this production
    - Critical Control Point Step 3 – Production Stage Flow Diagram Brood Stock Maturation, PL production, Juvenile and production growout.
    - Critical Control Point Step 4 - Hazard Analysis

C. **Establishing Mitigating Actions for All Critical Control Points**

Requires detailed action for all stages of the production cycle:

- Quarantine: importation of brood stock
- Breeding: brood stock, nauplii, post larvae, juveniles, sub-adults

- Maturation: brood stock, nauplii
- Hatchery: nauplii, post larvae
- Farm: post larvae, juveniles, sub-adults
- Processing: fomites, influent, effluent, final product, waste disposal.
-

D. **Determination of Existing Disease Status or Freedom from Disease**
   - Diagnostic Testing
   - Farm Records
   - Disease Surveillance

E. **Develop Contingency Plans**
   - ✓ Contingency Planning

F. **Monitor Progress & Audit Implementation**
   - ✓ Auditing and Certifying

G. **Certification of Biosecurity Levels or Disease Freedom**

H. Documenting the Biosecurity Zone Management Plan.
   - ✓ Biosecurity Plan Summary
     - Provide an outline of items to be covered including possible template:

General information
Introduction and background
Risk analysis
Major routes for disease transmission
Major disease hazards
General farm information

Biosecurity plan guidelines
Record keeping
Staff training
Property management
Protocols to address major transmission routes
Emergency procedures
Biosecurity Plan monitoring and audit

Biosecurity risk analysis
Identify the hazards
Complete risk assessment
Identify mitigating and risk management measures
Document the risk analysis process

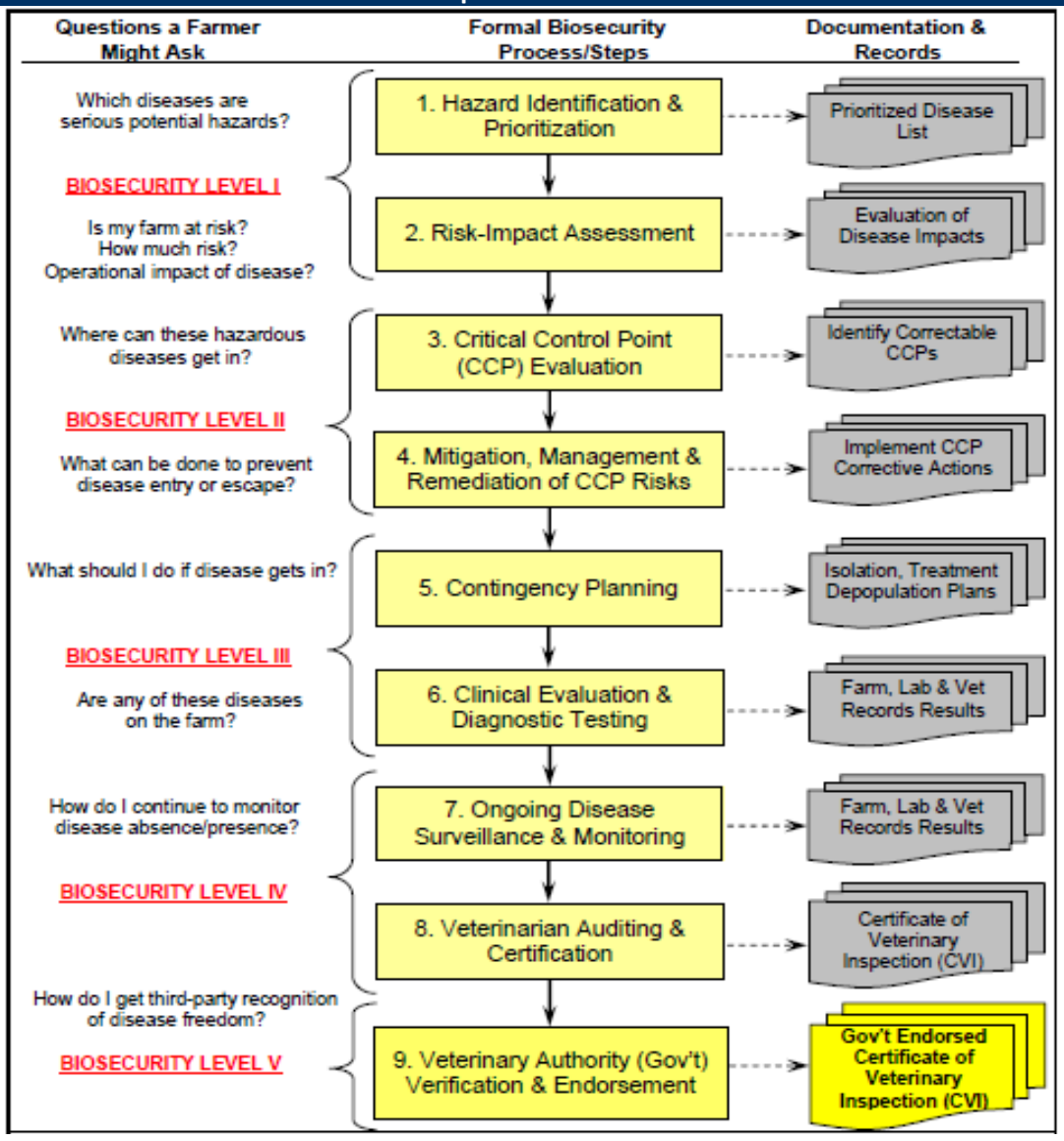
Biosecurity plan implementation
SOPs (Standard operating procedures)
Forms and checklists

Equipment
Signage
Staff training

Generic biosecurity plan template

As described, a systematic monitoring program and comprehensive data collection system will be developed to better understand the prevalence of pathogens and the effect of management practices and culture conditions on shrimp production performance.

Figure 10: General Aim to Integrate Biosecurity Requirements into an Implementable Plan



Source: A. David Scarfe PhD, DVM, MRSSAf, CertAqV Aquatic Veterinary Associates, LLC USDA-APHIS-VS (NAHERC) Bartlett, IL USA, "Practical Approaches to Implementing Aquaculture Biosecurity Programs & Meeting OIE Standards & Regulations." USAHA/AAVLD Annual Meeting; Aquaculture Committee, October 25, 2015 – Providence, RI

Spatial Planning Tool

A survey conducted by FAO and the World Bank[43] promoting the ecosystem approach to aquaculture, provides the conceptual guideline and operational tools for the smart spatial planning of marine aquaculture activities, including aquaculture zoning, site selection and area management. The assumption is that poor spatial planning can undermine the viability of businesses and the socio-economic benefits that can be derived from aquaculture development and lower its contribution to the "blue economy". This CDP will incorporate Geographical Information Systems (GIS) as an important component of the Biosecurity Aquaculture Zone mapping and as a major tool for integrating the project's monitoring and surveillance data as well as other existing public and private domain sources. The GIS will also:

a) overlay all these types of data into one map, manipulating it so that all the sources have the same scales and allowing complex readings to be taken from the map.
b) be involved in both the collection of geographical and spatial information and its storage, analysis and presentation and the development of internet applications to present GIS data and tools on industry websites.
c) use tools to combine or interface different GIS datasets and create new information or investigate patterns, e.g. estimating the number of farms potentially affected by diseases, flooding, critical indicators and critical control points for biosecurity management.

The application will also be able gather and update field and monitoring data using Global Positioning System (GPS) and other surveying instruments to compare and present a range of information, including:

- the geo-referenced location of farms, rivers, waterways, roads, coastlines.
- water quality information, soil data and vegetation
- results of shrimp health surveys and warning systems.
- integrate existing climate change vulnerability maps into the BAZMP.
- the position of streets and buildings and power lines.
- data on people, population distribution, education and income.
- creation of new data layers for inclusion in the BAZMP database.

In addition, other Belizean GIS data repositories will be accessed to obtain base map data and data layers relevant to the Biosecurity Aquaculture Zone Mapping as well as linking with other public domain GIS repositories to provide real-time data (sea surface temperature, Chlorophyll-a, salinity, water level, turbidity etc.) that can provide meaningful information to cluster stakeholders.

[43] Aquaculture zoning, site selection and area management under the ecosystem approach to aquaculture. Food and Agriculture Organization of the United Nations / The World Bank. Rome, 2017

3.3 Main Priorities and Required Activities

The Belize Shrimp Cluster has set the following priorities for the Belize Shrimp Biosecurity Aquaculture Zone Management Project and proposes the following required activities to execute the project:

Priority 1: Implement a Biosecurity Aquaculture Zone Management Plan (BAZMP)

Activities:

1.1 Hire a cluster facilitator to assist with the overall implementation of the cluster plan.

1.2 Conduct a biosecurity risk assessment, identifying disease risks and gaps in biosecurity measures to be carried out in the first 3 months of the project.

1.3 Develop a Biosecurity Aquaculture Zone Management Plan (BAZMP) in 12 months, but will be revised throughout the project's lifetime for adjustments and improvements.

1.4 Develop and adopt control measures and regulations, moving from voluntary to mandatory policies to be implemented over a 24 months' period.

1.5 Apply knowledge on disease control developed during the project for implementing new technology and improving culture methods and predictability. ICT will a major role in data collection and sharing as well as the use of GIS platform for database and knowledge management system.

1.6 Communicate project results with premium markets through promotion and marketing activities.

Priority 2: As part of the BAZMP, the Belize Shrimp Cluster will implement a surveillance and monitoring system to prevent shrimp diseases outbreaks along Belize's shrimp aquaculture zone.

Activities:

2.1 Intensify and improve the pathogens surveillance and monitoring in Belize's shrimp production zone to be implemented over a 24 months' period.

2.2 Develop standardized and systematic data collection system among cluster members: with an estimated cost of US$25,000 and to be implemented over a 24 months' period.

2.3 Develop an online database that will allow access to simple descriptive statistics to establish relationships between pond conditions and the prevalence of pathogens to be implemented over a 24 months' period.

2.4 Develop an early warning system for data collection and epidemiological data analysis to be used as a tool for surveillance and monitoring along Belize´s shrimp aquaculture zone to be implemented over a 24 months' period.

Priority 3: The Belize shrimp cluster will have established a capacity building program for Cluster members

Activities:

3.1 Conduct site visits to learn new technologies/best practices for disease management in other shrimp production regions, to be implemented over a 24 months' period.

3.2 Promote conferences in shrimp production best practices with emphasis in disease control/prevention, to be implemented over a 24 months' period.

3.3 Activity 3.3 Farm staff exposed to new technologies through field visits, invited experts, training in protocols.

Using the Belize Shrimp Cluster's priority objectives and existing competiveness and biosecurity challenges cited above as a framework, the following work plan including specific tasks and sub-tasks is submitted for consideration to accomplish the goals of the Project.

3.3.1 Proposed Project Schedule

A suggested two-year Project schedule is provided below. As elaborated more fully in Section 3.3.2 below, to maintain consistency and effective project oversight the Cluster strongly favors contracting a single consulting firm to execute a number of project activities.

Table 6: Proposed Project Gantt Chart

COMPETE CARIBBEAN

Annex 4 - Project Gantt Chart

Activity	sep	oct	nov	dec	jan	feb	mar	april	may	jun	july	aug	sep	oct	nov	dec	jan	feb	mar	april	may	jun	july	aug
	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24
Component 1: Design and Implement Biosecurity Aquaculture Zone Management Plan (BAZMP)																								
Activity 1.1 Establish project management and project governance structures																								
Sub-activity 1.1.1 Hire Cluster Facilitator to assist with the overall implementation of the cluster plan																								
Sub-activity 1.1.2 Form Technical Committee to oversee project implementation																								
Activity 1.2 Conduct biosecurity risk assessment, identifying disease risks and gaps in biosecurity measures																								
Sub-activity 1.2.1 Review regulations, practices, pathogens, local conditions																								
Sub-activity 1.2.2 Recommendations on monitoring and investigation activities and improved regulations and practices																								
Sub-activity 1.2.3 Review new knowledge from monitoring activities and impact of modified practices																								
Activity 1.3 Develop Biosecurity Aquaculture Zone Management Plan (BAZMP)																								
Sub-activity 1.3.1 Review recommendations from epidemiologists with stakeholders																								
Sub-activity 1.3.2 Define action plan																								
Sub-activity 1.3.3 Review by epidemiologists and finalization of plan																								
Sub-activity 1.3.4 Periodically Review and adjust BAZMP																								
Activity 1.4 Develop and adopt control measures and regulations																								
Sub-activity 1.4.1 Development of biosecurity standards and regulations																								
Sub-activity 1.4.2 Hire expert to assist in drafting policies																								
Activity 1.5 Apply knowledge on disease control implementing new technology and improving culture methods																								
Activity 1.6 Communicate project results with premium markets through promotion and marketing activities																								
Component 2: Design and Implement a Surveillance and Monitoring System to Prevent Shrimp Disease Outbreaks																								
Activity 2.1 Intensify and improve the pathogens surveillance and monitoring in Belize's shrimp production zone																								
Sub-activity 2.1.1 Onsite pathogen monitoring activities																								
Sub-activity 2.1.2 Surveillance program by real time polymerase chain reaction (RT-PCR) at BAHA																								
Activity 2.2 Develop standardized and systematic data collection system among cluster members																								
Sub-activity 2.2.1 Development of sampling protocols and training of key personnel at farm level																								
Activity 2.3 Develop an online database to establish relationships between pond conditions and the prevalence of pathogens																								
Activity 2.4 Develop early warning system for data collection and epidemiological data analysis																								
Sub-activity 2.4.1 Identify key performance indicators (KPIs) and define methods of measurements and calculations																								
Sub-activity 2.4.2 Develop electronic templates to harmonize the data																								
Sub-activity 2.4.3 Develop a standardized data base including reports for the use of producers																								
Sub-activity 2.4.4 Training - methods for measurement and calculation																								
Sub-activity 2.4.5 Statistical analysis of data and epidemiology studies																								
Sub-activity 2.4.6 Workshops to present and discuss information																								
Component 3: Establish Capacity Building Program for Cluster Members																								
Activity 3.1 Conduct site visits to learn new technologies/best practices for disease management in other shrimp production regions																								
Activity 3.2 Promote conferences in shrimp production best management practices																								
Activity 3.3 Farm staff exposed to new technologies through field visits, invited experts, training in protocols																								
Sub-activity 3.3.1 Aquaculture production systems best practices																								
Sub-activity 3.3.2 Hatcheries best management practices																								
Sub-activity 3.3.3 Farms best management practices and field visits																								
Sub-activity 3.3.4 Biosecurity protocols and standards																								

3.3.2 Detailed Procurement Requirements

Project implementation calls for the following key procurement requirements:

- Hire Cluster Facilitator:
    - Sub-activity 1.1.1: Hire Cluster Facilitator to assist with the overall implementation of the cluster plan
- To maintain consistency and effective project oversight throughout the Project, it is preferred to contract ***one consulting team*** to provide the following consulting services:[44] (emphasis added)
    - Execute the following activities:
        - Activity 1.2: Conduct biosecurity risk assessment, identifying disease risks and gaps in biosecurity measures
        - Activity 1.3: Develop Biosecurity Aquaculture Zone Management Plan (BAZMP)
        - Activity 2.3: Develop an online database to establish relationships between pond conditions and the prevalence of pathogens
        - Activity 2.4: Develop early warning system for data collection and epidemiological data analysis
    - Provide ongoing capacity building to Cluster private sector actors:
        - Activity 1.5: Apply knowledge on disease control implementing new technology and improving culture methods
        - Sub-activity 3.3.4 Biosecurity protocols and standards
    - Provide capacity building to BAHA and Cluster private sector actors;
        - Activity 2.1: Intensify and improve the pathogens surveillance and monitoring in Belize's shrimp production zone
- Hire consultant or consulting team to execute:
    - Activity 1.4: Develop and adopt control measures and regulations
- Hire consultant or consulting team to execute:
    - Activity: 2.2 Develop standardized and systematic data collection system among cluster members
- Hire consultant or consulting team to execute:
    - Sub-activity 3.3.1 Aquaculture production systems best practices
    - Sub-activity 3.3.2 Hatcheries best management practices
    - Sub-activity 3.3.3 Farms best management practices and field visits
- Utilize CCPF investment to fund the purchase of software for the Cluster:
    - Sub-activity 2.1.3: Purchase cloud software solution for standardized data base
- Utilize CCPF investment to fund the following activities:
    - Activity 1.6: Communicate project results with premium markets through promotion and marketing activities [45]
    - Activity 3.1: Conduct site visits to learn new technologies/best practices for disease management in other shrimp production regions [46]

[44] It has been indicated that there are a number of renowned academic institutions that reportedly have the expertise and capabilities to deliver these types of consulting services. These include: Universidad de Zaragoza, Spain, Atlantic Veterinary College (AVC) of the University of Prince Edwards Island (UPEI)- Canada, Norwegian Veterinary Institute (NVI) and Universidad Autonoma de Mexico.

[45] Priority trade shows that have been identified include Seafood Expo North America – Boston (March every year) and Seafood Expo Global – Brussels (April or May every year)

- Activity 3.2: Promote conferences in shrimp production best management practices

3.4 Market Driven Approach

For some time, Cluster actors have recognized that sustained market orientation is the path to sustained competitiveness and subsequent success in targeted niche premium ASC-certified markets. As such, Cluster actors have continually been involved in adapting their production systems, products and services to changing market requirements and trends in key markets.

Consequently, Belize has developed a specific image of special provenance in some retail markets, based on exceptional eating quality and environmental attributes, and maintaining such value requires consistency in production to ensure stable supplies to retailers. Belizean shrimp sells as a premium product on premium markets in Europe and North America. Improving the predictability and stability of production will allow for increasing the sales volumes within existing retail customers, and introducing the Belizean shrimp to additional retailers in demand of sustainable farmed shrimp carrying an image of trusted provenance.

Current market conditions are not a limiting factor for Belize shrimp growth. *In fact, markets conditions are the principal factor for sustained growth of the sector since the shrimp farms are certified under the ASC standard.* (emphasis added)

In terms of data collection, Cluster actors have already been collecting market data for some time that Cluster actors use to continuously respond to market requirements and improve product and service offerings. But as biosecurity issues have become key determinants of the Cluster's continuing competitiveness, collection of biosecurity-related data necessarily complements market data collection.

Developing a standardized and systematic data collection system for epidemiological data is called for during this Project and will be an important instrument towards permitting science based and data and market driven approaches to strategic and investment decision making within the Cluster. Cluster actors have expressed their commitment to provide the data required in the formats required to enable so that this proposed systematic data collection system is functional and effective.

[46] Ecuador has been preliminarily identified as an appropriate site visit location: "Ecuador accounts for close to 50% of farmed shrimp production in Latin America…[potential advantages include]: Low-intensity production model; Few large groups control the sector; Distance from the Asian shrimp industry; Use of probiotics; Use of local genetics; High level of control by government; Favorable tariffs with import markets; and, Learning from white spot outbreak in 1990's." Source: Gorjan Nikolik, "Marine Shrimp Farming Outlook." Rabobank Group, July 2017

3.5 Technological Improvement

Activities to build the Cluster's knowledge and technical capacities limitations to enable continuous innovation and the widespread adoption of both, appropriate biosecurity measures and production techniques are woven throughout this Project. The exact types of technologies to be deployed during this Project will be determined as a result of the Biosecurity risk assessment that will be conducted. However, it is anticipated that Cluster actors will receive considerable exposure to new technologies through field visits, invited experts and training in protocols and then will apply practices to enhance disease control by implementing new technologies and improving culture methods. Several potential technologies and/or innovative practices identified during the Project Team's site visits include:

- New genetic lines of post-larvae;
- Adapting and incorporating new technologies for shrimp production in Belize include "Bio-mimicry" utilizing rice-bran, natural microbial probiotics and symbiotics with enzymes solutions; 'semi-intensive' and 'intensive' systems utilizing lined ponds with additional aeration devices; and extensive systems utilizing low stocking densities, longer growing cycles to get larger shrimp for specialized markets;
- The use of PCR (polymerase chain reaction) kits for assessing the health of farmed shrimp and collaboration with other farms and BAHA;
- Laboratory and staff capabilities to monitor and assess shrimp health and water quality management; and,
- The possibility of Centralized Laboratory Services to facilitate farms, lower costs and get faster response times for management decision making.

In addition, ICT will a major role in data collection and sharing as well as the use of GIS platform for database and knowledge management system.

3.6 Gender

The continued development of the shrimp aquaculture industry offers some important opportunities for gender mainstreaming. First, two of the main shrimp farms involved in this Project, Cardelli Farms Ltd. and Tex Mar Too, are owned by women, establishing a relatively strong baseline for gender diversity in industry leadership. Linda Thornton, the owner of Cardelli Farms Ltd. Is widely viewed as a shrimp aquaculture pioneer and is especially active in industry leadership through her role as a member of the BSGA Board of Directors.[47] Further, many of the laboratory technicians located on several of the farms are women and this Project seeks to develop the technical capacities of farm laboratory staff, thus women are scheduled to be the recipients of significant technical assistance and training which should further enhance their stature in the industry.

[47] http://www.eatingwell.com/article/81229/green-success-story-sustainable-aquaculture-in-belize/

Finally and importantly, although men represent about 95% of the labor force in the shrimp farms themselves, women represent over 95% of the labor force in processing plants. As the Cluster recovers from the EMS outbreak and puts the biosecurity capabilities and infrastructure in place to reach pre-outbreak production and export levels, it is anticipated that additional jobs created as a result of increased shrimp production will be in majority in processing activities. Jobs in processing plants are mainly occupied by women and salaries paid have a direct impact on households with improved nutrition, health and education of children. The payment of additional salaries and local purchases of goods and services will also have a positive indirect impact on the local economy, especially among rural communities located around shrimp farms, including indigenous communities. Except for management positions occupied by people with university degrees, all basic and supervision jobs in hatcheries, farms and processing plants are occupied by people from surrounding communities with primary or secondary education level.

Employment in processing plants is also providing employees with training, which has an impact on both personal and community development. Employees learn new skills, which overtime may lead to access to better-paid jobs. Employees also improve their-knowledge on hygiene, health, nutrition and basic environmental matters such as waste management and water conservation. All the above knowledge will over time have positive repercussions on the quality of life in employee's households and communities.

3.7 Climate Change

Sustainable aquaculture production is determined by environmental factors for aquaculture activities that will increase the survival, growth, and reproduction of fish. It is estimated that by 2030, Central America will still produce less than 0.5% of greenhouse gas (GHG) emissions on the planet, yet it is already one of the regions most vulnerable to climate change. Climate change issues influence the quality and quantity of aquaculture production, and impacts on aquaculture production due to climate change issues differ depending on aspects such as its region, aquaculture practice systems, space, time, size, and changeability. The increase in atmospheric and sea temperatures, the reduction and instability of rain patterns and the rise in sea levels, together with the intensification of extreme meteorological events —such as droughts and hurricanes— will impact the production, infrastructure, ways of life, health and safety of the population, and will also weaken the environment's capacity to provide vital resources and services.

The primary drivers of climate change that threaten aquaculture activities are temperature-pressure, oxygen demand and decreased pH, water supply variation and uncertainty, severe climatic events, regularity of disease, virus and toxic outbreaks, sea level rise, and the uncertainty of captured fish supply for aquaculture feeds. Fluctuation of climate events such as changes in water temperature, annual precipitation, water

stratification and the shift of raining and dry seasons all changes the physiological, ecological, and operational aspects of aquaculture activities.

Changes in temperature and precipitation are the major causes of failure to pond aquaculture production and usually trailed with drought and flood seasons. These events have resulted in water stratification that harms cultured species especially in shrimp production. Moreover, climate change also causes disease to fish and shrimps in all stages of its growth.

Climate change has both direct and indirect impacts on fish stocks which are exploited commercially. Direct effects act on physiology and behavior and alter growth, reproductive capacity, mortality and distribution. Indirect effects alter the productivity, structure and composition of the marine ecosystems on which fish depend for food.

The Belize Shrimp Cluster actors' compliance with rigorous ASC certification requirements clearly demonstrates the Cluster's commitment to pursuing environmentally sound practices. This Project's focus on biosecurity issues is a natural extension of this commitment.

Still, the Belize Shrimp Cluster is exposed to all of these climate change threats, including changes in temperature, sea level and dry/rainy season fluctuations causing biophysical changes to shrimp production ponds such as high and low salinity exposing animals to diseases outbreaks and changes in temperature affecting animal growth. Further, climate change issues such as sea level rise, flooding, storm surges and land-based run-offs, extreme weather events may affect biosecurity by increasing the range of pests and pathogens, intensities of their occurrence and vulnerabilities of farmed animals to diseases. Diseases outbreaks may be triggered by changes in weather parameters like increasing water temperature or acidification, changes in precipitations patterns that increase or decrease salinity in water bodies used by shrimp growers. This may result in increases of nutrient, bacteria and pathogen concentrations in coastal waters. Tropical storms in the Caribbean Sea could also potentially move pathogens from one region to another. Finally, Belize's location in the hurricane belt is a constant and major threat to shrimp growers.

Consequently, Cluster actors have already taken some measures to mitigate climate change issues. For example, to deal with changes in salinity due to extreme dry seasons (drought) some farmers are implementing recirculation systems to reduce water salinity levels and minimize diseases outbreak events. Several farms have developed the infrastructure to capture, store and harvest rain water to better manage salinity levels. Further, the majority of Belize shrimp farms are located in savannah lands, relatively far from the coastline and largely buffered by mangroves, allowing some protection from sea rise, flooding and hurricanes.

The proposed Biosecurity Aquaculture Zone Management Plan (BAZMP) and its early warning model for an active surveillance program, will allow the Belize shrimp cluster to be prepared to predict potential outbreaks of aquatic animal diseases, track climate change indicators and adopt measures to prevent associated negative impacts on production systems.

Research and development activities should provide information to financial institutions such as the DFC and industry players such as BAHA, DOE, to understand the industry investment requirements, the risks and returns. Shrimp growers will also implement better management practices to minimize the disease risks in their operations which will reduce negative environmental impacts, increase the efficiency of production systems and potentially reduce greenhouse gas emissions per kilogram of shrimp produced.

3.8 Risks

As with any project, this CDP's project team will have to mitigate certain risks that could negatively affect the project's implementation. Project implementation risks and corresponding mitigation measures are presented in the table below:

Table 7: Risks and Mitigation Measures

Category of Risk (Financial/Operational/ Governance/ Monitoring/ Reputational/Social/ Environmental/ Regulatory)	**Detail**	**Probability of Occurrence (Low/Medium/ High)**	**Mitigating Measure/ Contingency Plan**
Financial	Cluster members could not be able to fulfill the financial commitment to this project	Low	• Cluster members will sign a letter of commitment. • Financial support will be based on monthly payments. • The president of the BSGA and the Cluster Facilitator will maintain constant communication with cluster members.
	Financiers could restrict lending due to the existing negative operating environment	Medium	• Restoring lender and investor confidence by establishing a standardized and systematic surveillance and monitoring data collection system that captures each farm's production methodology and corresponding yields, shrimp health and water quality, to allow for evidence-based decision-making on optimal production methods and improving predictability of producion levels and hence, sales.

Operational	Diseases outbreaks	Medium	• Heightened coordination between industry actors and between industry and relevant government actors will provide better conditions for prevention, control, mitigation of disease outbreaks.
	Weakness of biosecurity measures	Medium	• All producers agree to adopt the BAZMP protocols.
	Poor industry practices regarding: • movement of shrimp • husbandry practices • effluent water management	Low	• Project facilitator to ensure the implementation of a surveillance program and data analyses to develop better understanding of the effect of management practices on pathogen prevalence and define improved aquaculture practices.
Legal/regulatory	Non-adoption of mandatory regulations developed under this initiative	Low	• Cluster members will work together with an expert to draft the regulations that will help in disease outbreaks prevention. • The BSGA will collaborate with BAHA to facilitate the enforcement of regulatory measures.
Leadership/Political	The Ministry of Agriculture imposing unilateral regulations	Low	• Cluster members and the Ministry of Agriculture will work in close coordination with the relevant agencies to develop appropriate regulations regarding shrimp disease control.
Other	Disease movement on wild animals (birds) between farms.	Medium	• Agreements on coordinated production.
	Disease movement of people and equipment between facilities	Medium	• Movement restrictions and disinfection procedures
	Potential import restrictions due to diseased production in key export markets	Low	• BAZMP will be developed and implemented to coordinate actions in prevention, control, mitigation of disease outbreaks.

IV. Monitoring and Evaluation

4.1 List of Indicators to be Monitored

As the Cluster's commercial and socioeconomic goals are integrally tied to improved biosecurity conditions, preliminary commercial/socioeconomic and biosecurity indicators that will be monitored throughout the Project are provided in the table below:

Table 8: Preliminary Commercial/Socioeconomic and Biosecurity Indicators to be Monitored

Commercial/Socioeconomic Indicators	Biosecurity Indicators
• Increase in production • Increase in sales • Value of exports/year • Contribution of sales from exports • Number of new export markets • # of New Products Developed/Introduced • Pre-tax profits • % mark-up above commodity price • Employment full time • Employment part time • % women employed full and part time • # trained technical staff with capacities to better monitor shrimp diseases	Quarantine protocols Breeding and shrimp genetics Maturation Hatchery and farm water quality management • Pond water • Waste water • Marine ingredient management • Survival rate and disease rate Processing Value chain • Certify feed quality and sanitary controls • Certify sanitary controls with transportation providers • Evidence of meeting performance indicators for a functioning national biosecurity system • Credible evidence of BAZMP targets for implementation at producer level • Absence of specific pathogens supported by evidence for capacity to prevent and respond. • Meeting performance indicators for a functioning national system that addresses risk, including systematic surveillance and evidence for claims regarding health status • National and sectoral hazards, disease presence and impacts; • Policy and governance weaknesses, short medium, and term-term opportunities for improvement in management enterprise at sector and national level priorities and tactics for engaging enterprises in biosecurity management.

Baseline data for the commercial and socioeconomic data is actively being collected and this data; along with associated 2019 and 2020 targets, will be submitted with the Final CDP.

The final biosecurity indicators to be monitored will be determined by the Consulting Team that will be contracted to conduct the biosecurity risk assessment and develop Biosecurity Aquaculture Zone Management Plan (BAZMP), in conjunction with Cluster actors and the Cluster Facilitator.

4.2 Process for Collecting and Reporting Data

Through the execution of the Compete Caribbean Partnership Facility-funded (CCPF) project the Cluster participated in during Phase 1 of the program, Cluster actors have prior experience collecting and reporting commercial and socioeconomic data per CCPF's monitoring and reporting requirements. The Project Facilitator will aim to leverage this experience and replicate best practices where appropriate.

In addition, Cluster leadership and the Cluster Facilitator will rely on the expertise of the Consulting Team contracted to conduct the biosecurity risk assessment and develop the Biosecurity Aquaculture Zone Management Plan (BAZMP) to determine the appropriate process for collecting and reporting biosecurity data in conjunction with Cluster actors and the Cluster Facilitator.

Cluster actors, such as hatcheries, farms, processing plants and BAHA will be required to submit data as defined in the appropriate frequencies and in the appropriate formats per the roles established by the Consulting Team.

4.3 Responsibility for Consolidating and Analyzing Data

The Cluster Facilitator will have ultimate responsibility for monitoring, accounting and reporting systems, both in terms of for compiling and delivering relevant data to CCPF. As such the Cluster Facilitator will:

- Establish detailed project monitoring, accounting and reporting systems with appropriate indicators and milestones and will adhere to the protocols, processes and timetables therein;
- In tandem with the Consulting Team contracted to conduct the biosecurity risk assessment and develop the Biosecurity Aquaculture Zone Management Plan (BAZMP), determine the types, frequency and format of biosecurity data that will need to be submitted on a regular basis;
- Be responsible for collecting information that documents activities in the field including, process, number of participants, outcomes, associated financial

resources expended etc. and any other noteworthy developments from the field that could have a positive or negative impact on project implementation; and,

- Be responsible for collecting all data and inputs required to inform the project monitoring, accounting and reporting systems.

The Consulting Team contracted to conduct the biosecurity risk assessment and develop the Biosecurity Aquaculture Zone Management Plan (BAZMP) will be responsible for analyzing this data and communicating key findings to Cluster stakeholders at appropriate junctures throughout the duration of the Project.

The trigger for the Project's final evaluation will be the completion of Activity 3.3. Given the Project's relatively short time frame, the need for a formal project mid-term evaluation is not anticipated. Instead, any project modifications deemed necessary will be justified and submitted to CCPF by the Cluster Facilitator on an as-needed basis.

V. Sustainability

5.1 Governance Structure and Institutional Arrangements

The BSGA has developed a strong culture of collaboration both internally and externally (with governmental institutions and NGOs), which was further strengthened during the first CCPF project that achieved ASC certification of nearly all Belizean farms in 2015. It is envisioned that the proposed BAZMP will be overseen by a management body, such as a technical committee or working group, to be created.

Some partner organizations like the Belize Agricultural Health Authority (BAHA), and the International Regional Organisation for Plant and Animal Health (OIRSA) will act as key stakeholders to support the BSGA in the implementation and adoption of the BAZMP. The Belizean Ministry of Agriculture is a key stakeholder that has been supporting the Belize shrimp sector to ensure a recovery from the status. The BAZMP will cover all Belizean shrimp farms and hatcheries, including supply and receiving water bodies.

The BAZMP will be a critical tool to bring predictability to shrimp production in Belize, its implementation will ensure proper management practices and a monitoring program can successfully prevent disease outbreaks in the shrimp production zone thereby guaranteeing shrimp production. To be fully adopted and functional, the BSGA and the Belize Agricultural Health Authority (BAHA), will continue their ongoing collaboration establishing a policy making body with a mandate to fully adopt the BAZMP. A BSGA/BAHA technical group will monitor the level of compliance with regulations, discuss and assess weaknesses and challenges and propose periodic improvements for strengthening pathogen and disease controls. The BSGA will ensure communication with relevant government agencies on the evolution of the industry situation and needs for amending regulations.

The online database created during the project will allow the industry to more efficiently generate statistics to analyze the performance of the production systems. During Activity 2.4 Develop early warning system for data collection and epidemiological data analysis, a local technical staff from the farms and hatcheries trained during the project will maintain and improve the disease surveillance program, as well as develop an early warning and emergency response program based on new pathogens potentially affecting the industry in the future.

5.2 Budget for Maintaining the Cluster Operations

The total estimated budget of the proposed project is US$543,000. This proposed budget is comprised of US$400,000 CCPF investment (including US$10,000 investment in goods), and US$72,000 and US$71,000 in Cluster Cash and In-kind contributions respectively. [48] A high-level breakdown of the proposed budget is provided below:

Table 9: High-level Proposed Project Budget

Activities	COST			
Component 1: Design and Implement Biosecurity Aquaculture Zone Management Plan (BAZMP)	**Compete Caribbean (Cash)**	**Cluster (Cash)**	**Cluster (In-kind)**	**Grand Total**
Activity 1.1 Establish project management and project governance structures	$125,000		$1,000	$126,000
Activity 1.2 Conduct biosecurity risk assessment, identifying disease risks and gaps in biosecurity measures	$25,000		$2,000	$27,000
Activity 1.3 Develop Biosecurity Aquaculture Zone Management Plan (BAZMP)	$20,000		$4,000	$24,000
Activity 1.4 Develop and adopt control measures and regulations	$20,000		$1,000	$21,000
Activity 1.5 Apply knowledge on disease control implementing new technology and improving culture methods	$5,000	$72,000		$77,000
Activity 1.6 Communicate project results with premium markets through promotion and marketing activities	$15,000		$2,000	$17,000
Subtotal Component 1:	**$210,000**	**$72,000**	**$10,000**	**$292,000**
Component 2: Design and Implement a Surveillance and Monitoring System to Prevent Shrimp Disease Outbreaks				
Activity 2.1 Intensify and improve the pathogens surveillance and monitoring in Belize's shrimp production zone	$45,000		$45,000	$90,000
Activity 2.2 Develop standardized and systematic data collection system among cluster members	$20,000		$2,000	$22,000
Activity 2.3 Develop an online database to establish relationships between pond conditions and the prevalence of pathogens	$20,000			$20,000
Activity 2.4 Develop early warning system for data collection and epidemiological data analysis	$40,000		$4,000	$44,000
Subtotal Component 2:	**$125,000**	**$0**	**$51,000**	**$176,000**
Component 3: Establish Capacity Building Program for Cluster Members				
Activity 3.1 Conduct site visits to learn new technologies/best practices for disease management in other shrimp production regions	$15,000		$2,000	$17,000
Activity 3.2 Promote conferences in shrimp production best management practices	$15,000		$2,000	$17,000
Activity 3.3 Farm staff exposed to new technologies through field visits, invited experts, training in protocols	$35,000		$6,000	$41,000
Subtotal Component 3:	**$65,000**	**$0**	**$10,000**	**$75,000**
TOTAL:	**$400,000**	**$72,000**	**$71,000**	**$543,000**

[48] The cash contribution will consist of 8 shrimp farms applying for ASC recertification, @US$9,000 per farm. The Cluster will make its in-kind contribution through contributing technical and managerial staff time throughout the project. In-kind contributions will particularly intensive in relation to the farms' laboratory technicians contributing time towards activities related to intensifying and improving the pathogens surveillance and monitoring in Belize's shrimp production zone.

5.3 Revenue Streams and Funding Sources

As this Project is primarily scientific in nature it is anticipated that Project activities will largely run in parallel to private sector Cluster actors' ongoing commercial activities. The Cluster generated US$45 million in sales in 2014 and even with decreased production levels, still generated US$5.8 million in 2017.[49] As such, private sector Cluster actors' existing revenue streams through shrimp sales and any financing/lending agreements will continue to fund commercial activities and it is not expected that other expenditures will be necessary to sustain operations at the firm level.

In addition, as it is anticipated that the Project's activities will allow for evidence-based decision-making on optimal production methods, lender and investor confidence will be restored providing alternate sources of funding external to the Project which will help ensure financial sustainability after the project.

Once predictability of production systems and critical production mass have been achieved, the Cluster also aims to dedicating a percentage of each private sector Cluster actor's total sales to create a fund that would finance ongoing biosecurity monitoring and surveillance systems and sustain the Cluster's own internal R&D capabilities that are envisioned to be enhanced during the Project's activities.

[49] Belize Shrimp Growers Association

Annexes

The Annexes listed below were submitted separately from this document.

Annex 1 – Project Results Matrix

Annex 2 – Project Monitoring & Evaluation System

Annex 3 – Detailed Project Implementation Plan by Activity (Resources, Schedule & Budget)

Annex 4 – Project Gantt Chart

Annex 5 – Procurement Plan

Annex 6 – Quarterly Project Status Report

Annex 7 – Terms of Reference for Cluster Manager

Annex 8 – Cluster Members Information

Annex 9 – Cluster Leadership Disclaimer

Annex 10 – Letter of Commitment

Annex 11 – Preliminary Baseline Biosecurity Assessment

Annex 12 – Results from Biosecurity Risk Assessment Questionnaire