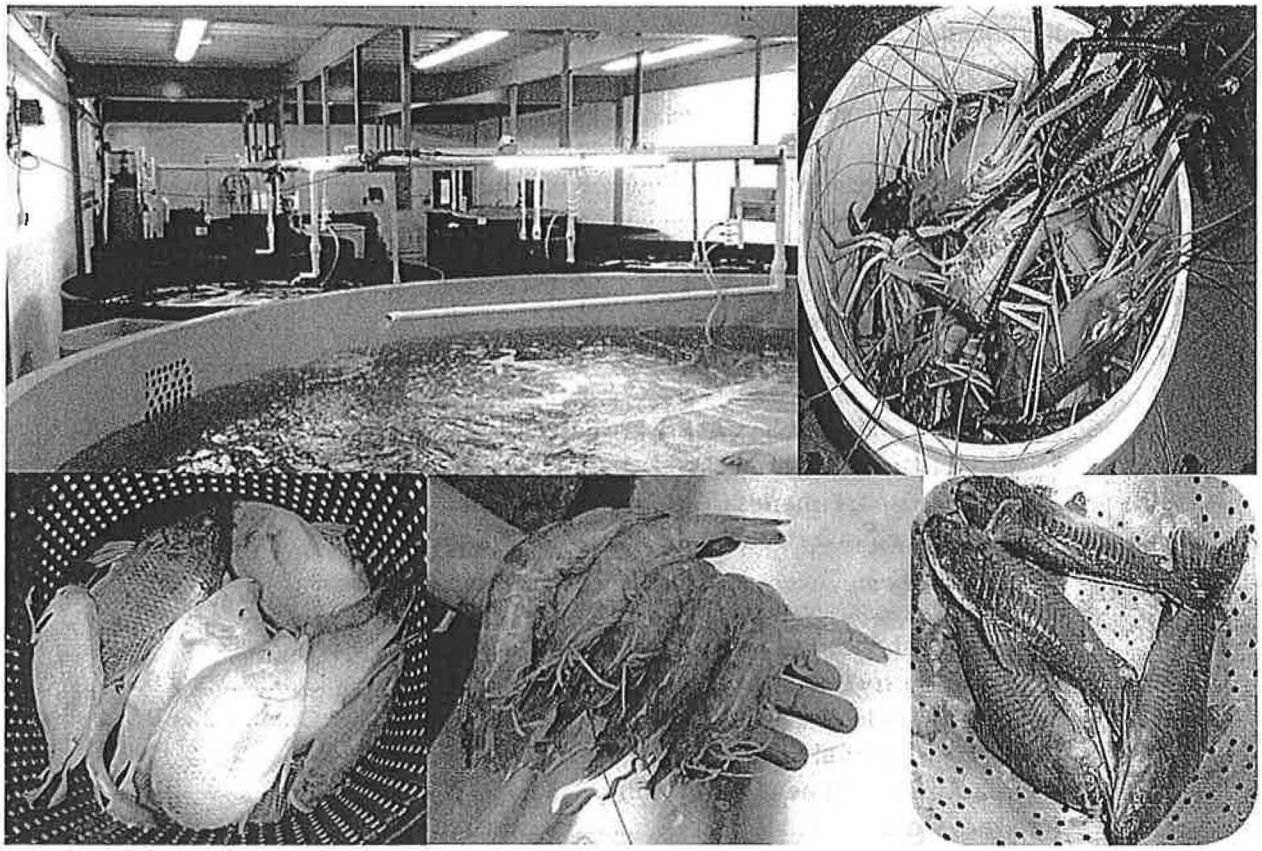

AQUACULTURE STRATEGIC PLAN:

A Framework for Sustainable Development in Trinidad and Tobago 2018-2023

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Contents

Preface

Aquaculture in Trinidad and Tobago has become synonymous with tilapia production and all the failures associated with tilapia. Accordingly, Trinidad and Tobago has made little progress in achieving real growth in the aquaculture sub-sector, despite various attempts at providing incentives, trying new species and new production systems and providing support to the industry through the public sector.

Still, interest in training and aquaculture development is high, though these interests end up being tied to State support for ponds, fingerlings, subsidized food, and access to State-sector procurement. There has been a noticeable increase in interest from entrepreneurs and the private sector, especially since the recent downturn in the economy and this provides opportunities for private capital to be capitalized into real aquaculture growth.

Aquaculture has the potential to enhance rural, urban and coastal resiliency, create jobs, increase national food security and human nutrition and is a valuable tool for endangered, threatened or protected species and aquatic habitats. Recent trends with the downward spiral of available seafood stocks, environmental changes due to global warming and sea-level rise, pollution of inland and nearshore waters make aquaculture a safe and viable option for aquatic and seafood production. Aquaculture is controlled animal husbandry and should be treated as agribusiness and a way for producers to realize profit while supplying quality products whether it is tilapia fillets, whole-fish such as cascadura, local delicacies such as black river conch or premium products such as marine shrimp. Still, there is room for other species and the farming of aquatic plants such as seaweed, farming of shellfish such as oysters, clams or mussels and incorporating production systems with vegetable farming with the use of aquaponics.

This 5-year Strategic Plan will seek to use the past experiences and present know-how and technologies supported by a unified public sector approach to develop a diverse portfolio of options for new entrants to the industry. In addition, current or historical producers will be encouraged to scale-up operations to provide fresh, reliable, quality products for sale and value-added inputs to the now more informed consumer. There are still some regulatory, technical and organizational needs required to advance aquaculture locally, but these will be addressed over the life-cycle of the Plan. This fresh look will highlight the critical areas, also bearing in mind that there are limited resources and they must be used strategically and wisely.

There has been much discussion with industry stakeholders including various government and State agencies, active producers, industry personnel, end-users and potential farmers. While the plan emanates from the Ministry of Agriculture, Lands and Fisheries, it has incorporated the invaluable feedback received from key government partners and private individuals and will reflect the needs of these stakeholders. It will be a work in progress as we reboot the developmental process to discard the unworkable models, keep and embrace the success stories, adopt innovation when it is successful and face the challenges ahead.

It will take continued teamwork and dedication for a national success story in aquaculture development and it will also take time to fulfil our objectives towards a sustainable aquaculture future.

1. Introduction

Background

The Government of the Republic of Trinidad and Tobago is committed to the principle of sustainable development, effective use and management of its marine and fisheries resources. The **Ministry of Agriculture, Land and Fisheries** (MALF) has a vision to be a client oriented, performance driven, environmentally responsible organization delivering integrated services aligned to a changing food and agriculture system. The mission of the MALF is to work as an innovative team, championing the conservation of biodiversity and sustainable development of food and non-food systems, supported by sound public policy[1].

The Ministry is currently undertaking a strategic review of the fisheries related activities, which will allow Trinidad and Tobago to work towards achieving the targets to end hunger, achieve food security and improved nutrition, promote sustainable agriculture and conserve and sustainably use of the oceans, seas and marine resources.

In 2016, a Working Group of representatives from government ministries and State organisations met to discuss a strategic plan for the fisheries sector including aquaculture to create a growth strategy for aquaculture in Trinidad and Tobago. A working document **Draft Strategic Framework for Sustainable Aquaculture Development in Trinidad and Tobago 2016-2020** was presented and provided a starting point for discussions. The aim then was to deliver a practical, industry-led plan for sustainable growth across the entire aquaculture value chain with government providing the enabling environment for development.

In March 2018, government MALF stakeholders met again to revise the strategic plan specifically to reduce existing duplication and overlapping amongst agencies within and outside the Ministry. The specific agencies include the **Aquaculture Unit** of the Fisheries Division (AU), the **Seafood Industry Development Company Limited** (SIDC), **Caribbean Fisheries Training and Development Institute** (CFTDI), **Sugarcane Feeds Centre** (SFC) and the **Institute of Marine Affairs** (IMA). A decision was taken by government to close the SIDC in 2017.

The strategic review should also provide recommendations for removal of this duplication, overlapping and identifying gaps which require attention. This Revised Strategic Plan will be submitted for approval by the Minister of MALF.

[1] http://www.agriculture.gov.tt/foodproduction/index.php?option=com_content&view=article&id=75&Itemid=45&lang=es

Trinidad Aquaculture

Trinidad and Tobago is predominantly a natural gas and oil-based economy with petrochemical industries providing over 44% of the gross domestic product[2]. The aquatic animals cultured in Trinidad and Tobago include red and silver tilapias, cascadura, freshwater prawns, marine shrimp and ornamental fish (Table 1). Aquaculture is still an emerging industry although there have been some successes in small-scaled fish farms and in ornamental fish breeding, farming and exports. However, increased demand for fish and fish products, coupled with declining and potentially declining stocks as well as the need for diversification in the local economy have seen a renewed interest in aquaculture as a source for fish and as a potential business[3].

Table 1. Major Aquaculture Species in Trinidad and Tobago

Common name	*Species*	Status
Tilapia	*Oreochromis niloticus*	Over 100 registered farmers, mostly small-scale to medium enterprises
Cascadura	*Hoplosternum littorale*	Mostly polyculture, small holdings
Crayfish (Malaysian prawn)	*Macrobachium rosenbergii*	Small-scaled and polyculture with tilapia and cascadura
Marine shrimp	*Litopenaeus vannamei*	Pilot and research
Ornamental fish	Huge variety	Local and export markets

The potential for marine aquaculture is huge but pilot projects and research trials have not yet been converted into commercial success. The snapper species of importance are the southern red snapper *Lutjanus purpureus*, lane snapper *L. synagris* and the vermilion snapper *Rhomboplites aurorubens* while the grouper species most commonly targeted are the yellowmouth (Epinephelus flavolimbatus), and yellowedge grouper Mycteroperca interstitialis. However, there are numerous species that may be cultured in Trinidad and Tobago which include: *Lutjanus analis*(mutton snapper), *L. griseus* (gray snapper), *L. jocu (*dog snapper), *L. mahogani* (mahogany snapper), *L. synagris* (lane snapper), *L. purpureus* (southern red snapper), *Epinephelus adscensionis (*rock hind*), E. guttatus (*red hind*), E. fluvus (*coney*), E. itajara (*jewfish*), E. cruentatus (*graysby*), Mycteroperca venenosa (*yellowfin grouper*) and M. tigris (*tiger grouper*).* [4]

[2] Longmore, R., P. Jaupart, and M.R. Cazorla. 2014. *Toward Economic Diversification in Trinidad and Tobago*. World Bank Policy Research Working Paper No. 6840. 35 pp.

[3] Gabbadon, et. al., GCFI:67 (2015).

[4] http://www.ima.gov.tt/home/research/fisheries-and-aquaculture-.html

There has been Government support for aquaculture development in Trinidad and Tobago through various national aquaculture policies, programs and activities in both the public and private sectors to encourage development. There is an imminent need to scale-up all aquaculture production and development of viable economic models for the establishment of aquaculture businesses and attracting farmers, entrepreneurs and investors. Aquaculture is a business involving live animals and has the competitive advantage of being able to be harvested and have fresh, chilled, value-added and on-ice product in a few hours to produce quality seafood.

2. A vision for Aquaculture Growth

Role of Aquaculture

Aquaculture can play a key role in the transition toward safer, more environmentally and economically sustainable seafood production, offering a viable, safe and sustainable alternative to fishing wild stocks and one that can bring strong economic benefits. However, we need to have more seafood production systems to meet exploding consumer demand for seafood, determine appropriate technologies, best management systems and fine-tune for lower production costs.

Trends

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 tonnes in 2022[5]. 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.

World Capture Fisheries and Aquaculture Production[6]

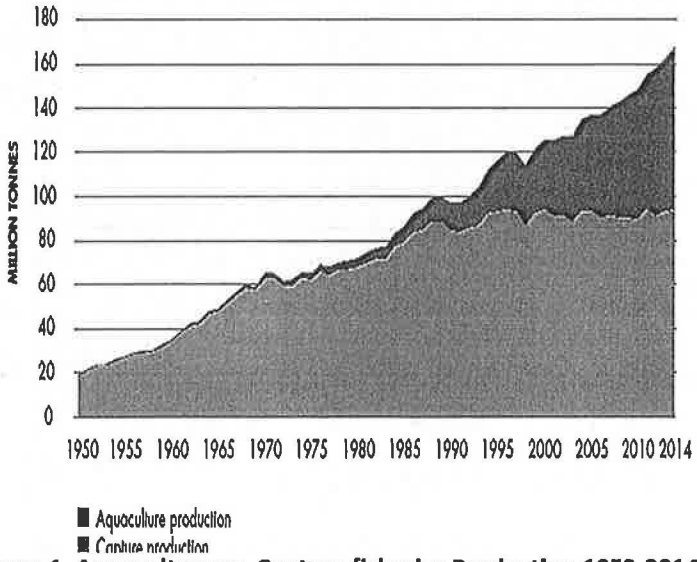

Figure 1. Aquaculture vs. Capture fisheries Production 1950-2014

The future of the Trinidad and Tobago seafood industry must include aquaculture and there is a unique opportunity to drive this fledgling industry forward in a way that enhances national food security and also meets our economic and environmental needs. Demand for seafood is growing but the domestic wild harvest is insufficient to meet new

[5] FAO 2014. The State of World Fisheries and Aquaculture. FAO, Rome, Italy. 223pp

[6] The State of World Fisheries and Aquaculture. ©FAO, 2016 - I5798EN/2/01.17

and increasing demands. Many regional and global competitors have seized this market opportunity often affecting local producers, prices and outcomes.

Aquaculture is expected to provide most of the increase in fish production, with the outlook for venturing into and remaining in aquaculture being highly favourable. 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[7]. 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 urbanisation.[8]

Changes in Approach

For aquaculture to overcome the slow pace of development and critical challenges faced in Trinidad and Tobago, significant changes in approach are required. This requires a new phase of implementation with the input of private investment in the form of PPP (Public-private Partnerships) or independent investments with or without Government support. This is a huge opportunity for sustainable businesses that can make excellent returns and penetrate new markets. Whilst there are opportunities for small-scale aquaculture and aquaponics, the mindset of 'backyard farming' and artisanal farming as the only way forward must be changed.

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.
- 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 freshwater and marine food production.
- Used to provide technical knowledge to stakeholders and offer training on sustainable freshwater, brackish and marine production systems.

[7] FAO 2010. The State of World Fisheries and Aquaculture. FAO, Rome, Italy. 197 pp.

[8] 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.

Aquaculture Benefits

Aquaculture offers a unique complement of environmental, economic and social benefits to communities providing alternatives that are both environmentally and economically sustainable while fostering independence and self-sufficiency. Specific benefits include the following:

1. **Provides an environmentally sustainable alternative to fishing & trawling,** reducing pressure on wild fish stocks while offering employment alternatives for displaced fishers and seafood industry workers.
2. **Provides an economically sustainable alternative to the *status quo*,** including an uncertain future for Gulf of Paria fishing. Sustainable aquaculture production will be designed from the ground-up to be a profit center and will represent a long-term investment in communities not simply a short-term public assistance measure.
3. **Fosters community self-sufficiency and independence** through the development of an enduring, community-friendly industry with strong growth potential, energy independence, and the ability to withstand future hurricanes, oil spills and other catastrophic events. **Lays the foundation for a long-term growth industry** including the development of new national markets, including value-added seafood products (e.g., dried fish/shrimp, fish/shrimp paste, smoked fish, soup packs, fillets) designed for local communities and export.
4. **Offers rich socioeconomic community benefits,** including green jobs, opportunities for enterprise investment and innovation, the creation of new markets, etc.
5. **Realizes strong synergies with and strengthens the concept of the Aquaculture Farm,** which may serve as a national model and showcase for a more sustainable alternative to traditional large-scale food production.
6. **Reduces net greenhouse gas emissions** through reduction in transportation costs and suitability for alternative energy sources, including solar, wind and anaerobic digestion, which can be used for a combination of animal and vegetation waste.

FACTORS THAT MIGHT AFFECT THE PROSPECTS FOR THIS SECTOR

- **land and water and associated conflicts**
- **feed, seed supply and genetic resources**
- **environmental integrity and disease problems**
- **development and adoption of new and improved farming technologies**
- **market, trade and food safety**
- **climate change**
- **investment capital impediments**
- **unguided and unmonitored aquaculture practices.**

The State of World Fisheries and Aquaculture.

Drawbacks to Local Development

There are eight Government ministries that directly affect the aquaculture industry with significantly more government departments involved. This has resulted in overlapping of responsibilities, duplication of effort and extended lag-time for importation of supplies, equipment or products. In addition, at least three aquaculture fish farmers group and splintered individual farmers complete

the stakeholders. There is one local company making fish feed but there are complaints of pellet instability in water, poor composition and inadequate and inconsistent amounts available for farmers. Problems in obtaining foreign exchange for importation of quality feeds, often sold at high prices exacerbate the problems.

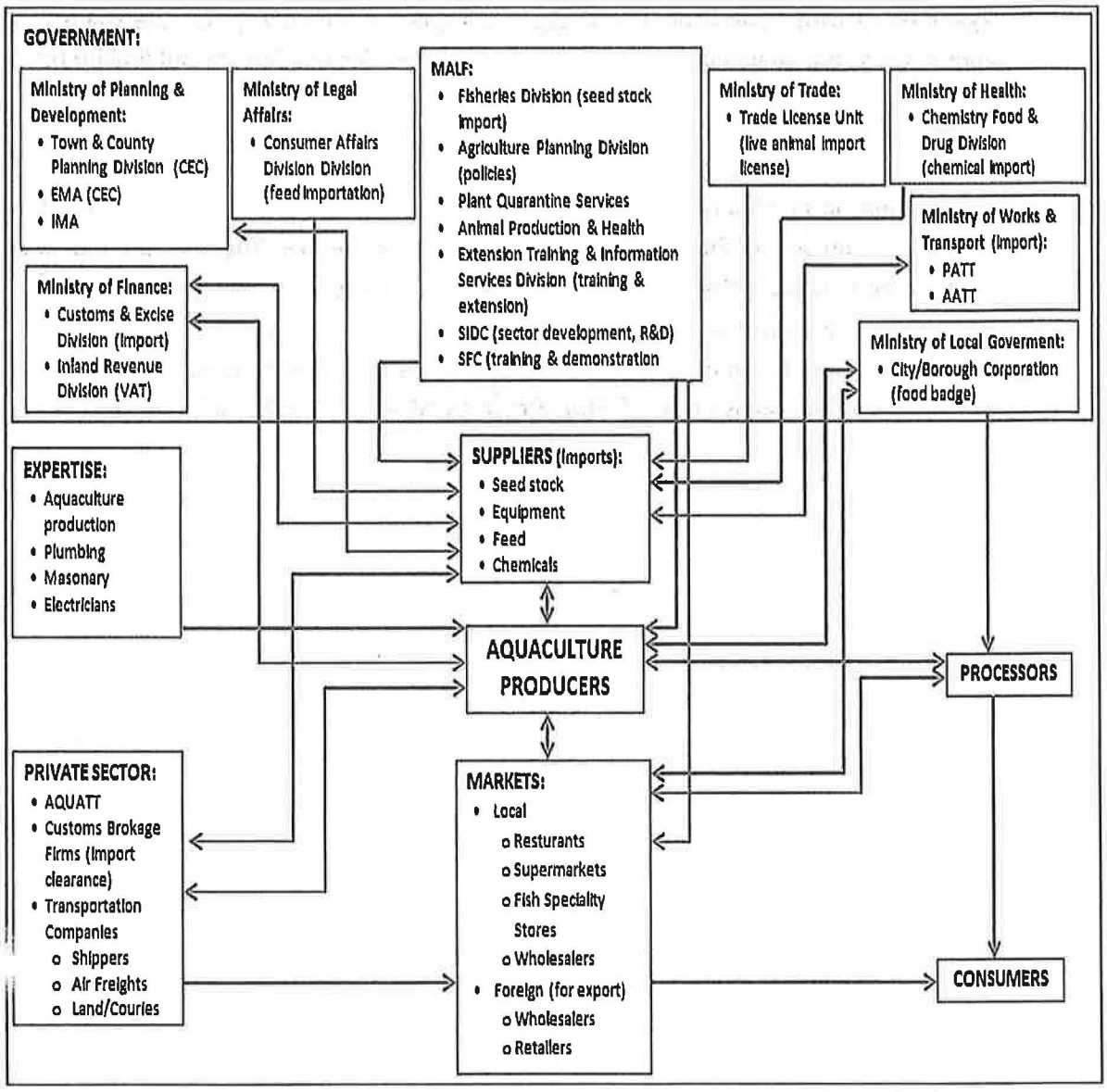

Figure 2 Complex Interactions for the Aquaculture Industry in Trinidad and Tobago.

There is also unclear expectations of the role of aquaculture as a sustainable developmental option and a business choice both in the public and private sectors, respectively. In addition, government agencies and sector stakeholders often give varying information for production systems, methods and business models.

3. Aquaculture in the Public and Private Sector

The local aquaculture industry includes a broad network of individuals, government institutions and organizations with aquaculture knowledge and experience, to strengthen the ability to implement large-scale, sustainable food production systems. These include but are not limited to:

Ministry of Agriculture, Land and Fisheries

Aquaculture Unit, Fisheries Division.

The Aquaculture Unit offers training to Aquaculture Farmers through Commercial Aquaculture Training Courses at the Aquaculture Demonstration Centre. There a few farmers who have managed to upscale their operations to commercial status.

Animal Production & Health.

The Veterinary Diagnostic Laboratory (VDL) is the only Government Veterinary Laboratory in Trinidad and is mainly involved with effecting and supporting National Health Policies and food safety standards and systems through diagnosis of livestock and major diseases in animals from both the public and the private sectors. This is primarily by means of laboratory testing and research as well as library facilities, seminars and training sessions.

State Agencies

Sugarcane Feeds Centre (SFC)

The Sugarcane Feeds Centre (SFC) is an institution of applied research, demonstration, development and training in tropical livestock production located in Longdenville, Central Trinidad. The line ministry is the MALF. One core area of the SFC work programme is integrated aquaculture, with tilapia, cascadura and Black river conchs being cultured. The SFC has a recently built hatchery for large-scale cascadura production.

Caribbean Fisheries Training and Development Institute (CFTDI)

The Caribbean Fisheries Training and Development Institute (CFTDI) provides training and development in both seamanship and fisheries technologies for the Caribbean. It was incorporated as a Regional Body in 1975 under the laws of Trinidad and Tobago (Act #59 of 1975)[9]. They facilitate research and development, provide accredited technologically-driven training and related services for fisher folk, seafarers and other stakeholders in accordance with international standards, in harmony with the environment, in the context of sustaining a viable fisheries industry.[10]

[9] http://cftdi.edu.tt/new/history-of-the-institute/

[10] https://www.facebook.com/pg/caribbeanfisheries/about/?ref=page_internal

Seafood Industry Development Company (SIDC)

The SIDC is no longer involved in aquaculture as it has been dissolved effective July 9, 2017. However, there is a wealth of knowledge, highly-skilled and trained personnel in recirculating aquaculture systems for marine and freshwater and brackish-water systems.

Institute of Marine Affairs (IMA)

The Institute of Marine Affairs (IMA) is a multi-disciplinary marine and environmental research organisation established by Act of Parliament (Chap. 37:01 of the Revised Laws of the Republic of Trinidad and Tobago, as amended by Act No. 13 of 1990). The IMA is located in Chaguaramas and conducts research and acts in an advisory capacity to government. The Line Ministry of the IMA is the Ministry of Planning and Development. The Institute generates and implements aquaculture research within the industry utilising freshwater and marine systems[11].

The IMA is willing to serve the needs of the aquaculture industry by providing relevant research and development on a timely basis. They will, however, need an increased human capacity and infrastructure base and widening of the scope of study areas. In addition, closer collaboration with tertiary institutions that offer studies in aquaculture food production systems and the seafood value and supply chain will prove beneficial.

National Agricultural Marketing and Development Corporation (NAMDEVCO)

The National Agricultural Marketing and Development Corporation (NAMDEVCO) is a Statutory body created by Act of Parliament No. 16 of 1991 with a mandate to create, facilitate and maintain an environment conducive to the efficient marketing of agricultural produce and food products through the provision of marketing services and the stimulation of business investment in the agro-industrial sector of Trinidad and Tobago[12]. NAMDEVCO manages two wholesale fish markets, located at Port of Spain and Orange Valley. The Port of Spain Wholesale Fish Market is the main market for the wholesaling of fish in Trinidad and Tobago, whereas, Orange Valley is one of the major points for the sale of shrimp in the country[13].

Agriculture Development Bank (ADB)

The Agricultural Development Bank (ADB) is an agency under the Ministry of Agriculture, Land and Fisheries with the mandate to encourage and foster the development of agriculture, commercial fishing and associated industries, i.e. the 'farm to plate' concept including all segments of the production chain-support services, marketing and agro-processing.[14] The ADB is

[11] http://www.ima.gov.tt/home/

[12] http://www.namdevco.com/aboutus/namdevco-profile/

[13] http://www.namdevco.com/services/wholesale-markets/

[14] http://www.adbtt.com/About/

the only financial lending institution dedicated to the agricultural sector and provides a variety of loans geared to support farmers and agri-entrepreneurs.

Private Sector

Three private sector groups the Aquaculture Association of Trinidad and Tobago (AQUATT), the Tilapia Growers Association (TGA) and Tilapia Hatcheries group along with individual farmers advocate for their industry interests. A lack of cohesion and consistent organisation has been prevented them from being a unified voice for aquaculture in Trinidad and Tobago. Some of these groups also offer training and consultancy services to their associated members.

4. How to Promote Growth in the Sector

Aquaculture needs a cohesive and consistent effort from all the interested parties play. Aquaculture growth can be promoted by the following:

- Decide **appropriate technologies, best management systems** and **fine-tune for lower production costs.**
- **Knowing the economics** of setting up aquaculture businesses and attracting farmers, entrepreneurs and investors.
- **Reduction in importation of seafood products** leading to improved quality in the local value chain and food security.
- **Scale-up all aquaculture production** in Trinidad and Tobago and move towards the **commercialization of new and existing aqua-farms.**
- **Earning foreign exchange** from eventual export of aquaculture products.
- Introduction of new aqua-businesses and sustainable livelihoods and more aquaculture production systems to meet exploding consumer demand for seafood.
- Diversification of the national economy and agri-business enterprises

- ➢ Leadership and a driver for the industry.
- ➢ 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 operations.

Regulatory Framework

There is no dedicated legislation for Aquaculture development in Trinidad and Tobago but various Acts, rules and policies directly affect the industry. The regulatory frame for aquaculture development is affected by the following:

- Environmental Management Act, Chapter 35:05
- Certificate of Environmental Clearance Rules, 2001
- Certificate of Environmental Clearance (Designated Activities) Order, 2001 (as amended)
- Certificate of Environmental Clearance (Fees and Charges) Regulations, 2001
- Water Pollution Rules, 2001, as amended by the Water Pollution (Amendment) Rules, 2006
- 2006 National Environmental Policy
- Food and Drug Act Chapter 30:01
- Municipal Corporation Act Chapter 25:04
- Town and Country Planning Act Chapter 35:01
- Water and Sewerage Act Chapter 54:40
- Animals (Disease and Importation) Chapter 67:02
- Fisheries Act Chapter 67:51
- Occupational Safety and Health Act Chapter 88:08
- Sustainable Development Goals

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[15] with specific focus Sections 6, 7 and 14.
- Code of conduct for responsible fisheries[16] with specific focus on Article 9: Aquaculture.
- Manual of Diagnostic Test for Aquatic Animals[17]

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 management, water supply infrastructure
- **Reducing dependence on chemicals** through disease prevention.
- **Develop hatchery** production of fry, fingerlings 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, better quality feed, and better quality seed will all reduce the likelihood of disease and the need for and use of chemicals.
- **Shift** from high exchange systems to more closed systems where minimal water exchange takes place in the production tanks, and water quality is maintained using intensive aeration and manipulation.

Research and Development

The importance of Research and Development cannot be over-emphasized, but this must lead to business outcomes, the recruitment and retention of key industry professionals that will develop proprietary processes and know-how. The creation of intellectual property, not easily duplicated by others, gives competitive advantage. The value of strategic investment by Government in research and industry creation cannot be discounted and the collaboration between aquaculture stakeholders, both in the public and private sectors, has shown that there is a commitment to promoting safe and sustainable aquaculture businesses.

Research and development activities should provide information to financial institutions such as the **ADB** and industry players such as **InvesTT** to understand the industry investment requirements, the risks and returns. This activity must engage, inform, educate, and empower the supply chain to work together to 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

[15] FAO. 2012. Code of Practice for Fish and Fishery Products, Second Edition. World Health Organization. Rome. 250 pgs.

[16] FAO. 1995. Code of Conduct for Responsible Fisheries. Rome. 41 pgs.

[17] OIE. 2003. Manual of Diagnostic Test for Aquatic Animals, Fourth Edition. Paris. 358 pgs.

the marketplace. This is a huge opportunity for sustainable businesses that can make excellent returns and penetrate new markets.

The IMA and SIDC were involved in research and development work while some research work is also done by the **UWI** and **UTT** but this will need significantly more coordination and collaborative efforts to make an impact. Prioritization of research and development work must be done to conduct practical research that will diversify production and prove the practicality of new technologies. This work should also be directed to improve farm productivity and sustainability, reduce input costs and increase farm-gate income and downstream value added products. This applied research answers biological or technical challenges that benefit farmers raising aquatic plants, aquaponics, shrimp, food-fish and ornamental fish.

Quality Assurance

Quality assurance has been identified as one most important aspects for improvement in the seafood value chain. The **CFTDI** can play a major role in the quality assurance of seafood and improve focus to satisfy consumer requirements and preferences.

Since over 50 percent of the fish 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.[18]

Marketing

The marketing of some local aquaculture products remains a challenge. Engaging seafood retailers, wholesalers and exporters in the utilization of aquaculture products should also be a priority. Previous attempts at marketing aquaculture products, specifically tilapia, had limited success due to inadequate and consistent supplies and dependence of government subsidies. Aquaculture products have significant impacts on the world market. Sometimes, supplementing or replacing existing capture fishery products, developing new market opportunities through improved availability, novel products and/or improved market chain efficiency.[19] A new approach, including direct sales, niche opportunities as well as using the existing seafood supply infrastructure are just some of the options. Recent experiences with tank-raised shrimp at the **SIDC** suggest that immense potential exists if a quality, fresh and wholesome product is offered[20]. This effort must come from producers, wholesalers and retailers.

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[18] 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.

[19] 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.

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

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. Both major universities (**UWI** and **UTT**) offer undergraduate courses and post-graduate research work in aspects of aquaculture. However, the need for consumer-based education in the use, handling and preparation of aquaculture products and the determination of quality products cannot be overemphasized.

Training and Extension

There is a plethora of aquaculture training courses offered in Trinidad and Tobago by both private and public sector providers at varying technical levels. These include both short-term, hands-on and classroom type activities. The successful outcome of this training is still undecided and requires proper coordination of content, timing, and target audiences. Advisory services are offered primarily by state institutions (**SFC, IMA, FD,**) with the Aquaculture Unit of the MALF offering extension services to farmers.

While agriculture extension services are clearly defined for various crops, there is no specific setup for aquaculture extensions agents. 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.

Dedicated teams for specific issues such as water quality management, breeding, fish health management, production and marketing of products as well as species-specific information 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.

Fish Health Management

Regulatory protocols or 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 extension officers and farmers in Trinidad and Tobago 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 aquaculture industry and is potentially a further threat to marine fish stocks in Trinidad and Tobago[21].

A project by the UWI School of Veterinary Medicine entitled "**Enhancing national health standards in aquaculture systems: increasing aquaculture productivity, improving industry sustainability and reducing deleterious aquatic habitat impacts**" has been recently approved by the GEF SGP National Steering Committee and is due to start in August 2018. The project seeks to improve the sustainability of freshwater and marine aquaculture production by supporting the implementation of stricter biosecurity measures for farmers and extension officers, developing policy recommendations that may be used to inform future national legislative reform, as well as establishing educational outreach initiatives targeted at key stakeholders. This project will emphasize to farmers and extension officers the importance of incorporating health monitoring practices into an effective, structured, nationwide aquaculture farm management programme. This project is very timely and should be incorporated in the overall industry framework.

[21] GEF SGP PROJECT PROPOSAL. 2017. UWI. Enhancing National Health Standards in Aquaculture Systems: Increasing Aquaculture Productivity, Improving Industry Sustainability and Reducing Deleterious Aquatic Habitat Impacts. 46p.

5. Strategic Priorities and Recommendations

The strategic priorities for the aquaculture sector for Trinidad and Tobago to deliver high levels of sustainable growth by 2020 and beyond, seven strategic priority areas were identified. These are:

1. Leadership and a driver for the industry
2. Effective collaboration between government, state agencies, industry, and farmers
3. Accelerating innovation and production
4. Harnessing available skills
5. Public-sector private partnerships (PPP)
6. Appropriate marketing initiatives
7. Scaling-up of operations.

Within these seven areas of strategic emphasis, specific action items are articulated. In particular, five actions are critical to the sustainable growth of aquaculture in Trinidad:

- Formation of an **Aquaculture Industry Group (AIG)** to drive sector growth and ensure alignment between industry and government agencies.
- Formation of **National Aquaculture 'Hub'** a virtual network that creates the opportunity to develop the industry under one government Ministry, the **MALF** for all aspects of aquaculture.
- **Utilize existing information and experiences** to fast-track slow development pace in the industry.
- Better **application of available skills in the public sector** and institutions across administrative divides.
- Seek out and **promote aquaculture as a viable business** with entrepreneurs and business people to better access private capital and human resources.

Actions Required

These ten actions may be undertaken by the State, by private sector, or a combination as appropriate, but must be financially supported through the Public Sector Investment Programme(PSIP), recurrent expenditure, financial institutions (ADB and commercial banks), international grants, private funds from aquaculture farmers, entrepreneurs and investors to:

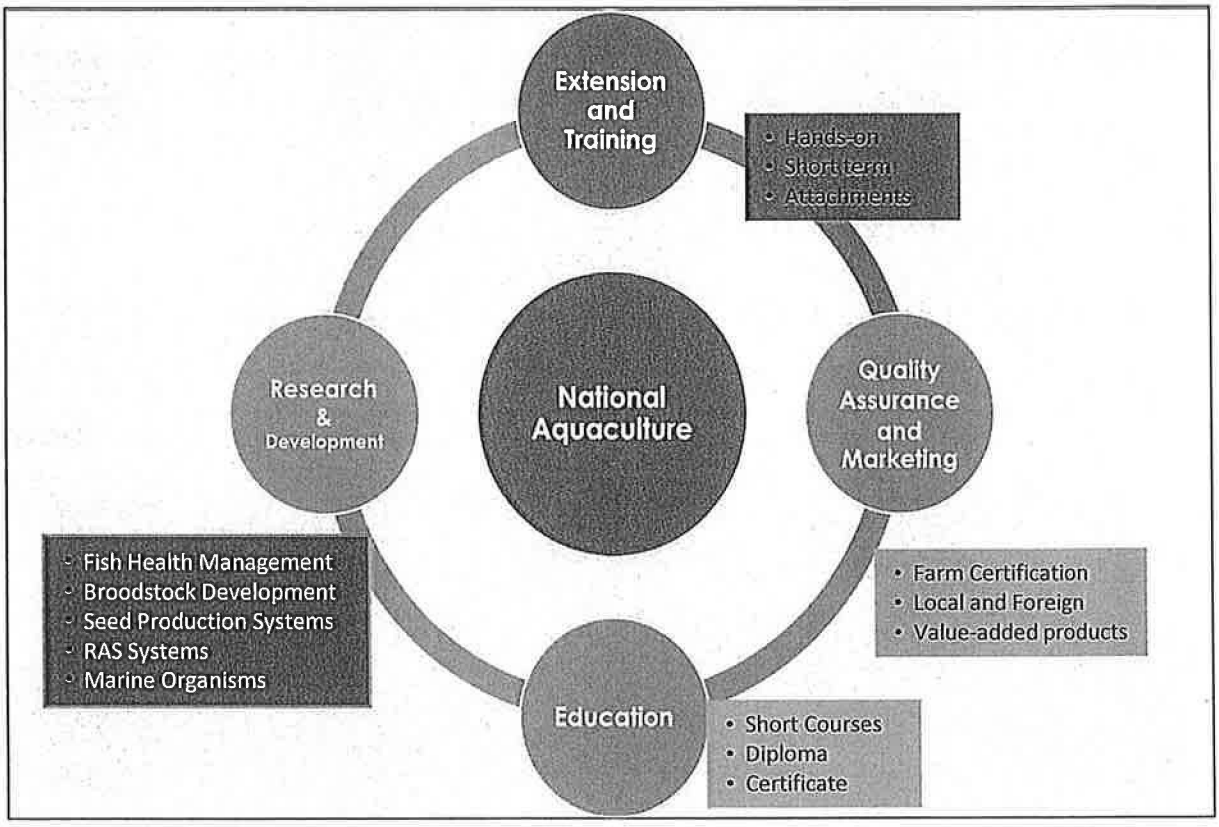
1. **Build capacity and scale in the industry**. Strengthen existing training and extension for knowledge and skills development, including technical, marketing and business management.
2. **Support new entrants to the aqua-business sector**. Create an open access online platform where entrants can access reports, share experiences, as well as communicate with each other freely. Social media platforms could be a follow up to this step.
3. **Facilitate national discourse on Aquaculture for development and diversification**. Develop research on existing and alternative high-value species that could be cultured locally. Development of commercial-scale growing systems for novel species. Provision of expert advice to improve environmental and business performance.
4. **Impress on the need to grow production, value and employment in the aquaculture sector**. Utilize existing public electronic as well as social media to get message to stakeholders. Increase processing and value-added "component" to all phases of production.
5. **Develop the aquaculture sector in compliance with environmental and health laws** and with the confidence of stakeholders. Include participatory approaches in planning and implementation and monitoring of socio-economic sustainability.
6. **Foster knowledge, innovation and technology transfer** to take advantage of opportunities for growth and better business management systems. Support best husbandry and disease management practices.
7. **Streamline an efficient licensing and funding system** that provides greater business certainty to applicants and more transparency to the general public.
8. **Provide certification of quality aquaculture production systems and products**. Collect detailed information on existing and new projects to be able to analyse data and evaluate through standardized methods and utilizing best management practices.
9. **Develop marine aquaculture planning activities** to allow for sea ranching or cage culture production. Identify additional potential species for consideration, shrimp, shellfish, groupers, snappers.
10. **Collaborate, communicate and connect** all stakeholders in public and private sectors. Reduce overlapping and duplication of activities between industry, scientific and development bodies. Organize a **National Aquaculture Symposium**.

Table 2. Strategic Priorities and Recommendations for Aquaculture in Trinidad and Tobago

Recommendation	Strategic Priority	Responsibility	Action Items	Timeframe
Formation of an Aquaculture Industry Group	Leadership and a driver for the industry Collaborate, communicate and connect	**AU, CFTDI, IMA, AQUATT, SFC, SVMUWI**	All stakeholders in public and private sectors. Reduce overlapping and duplication of activities between industry, scientific and development bodies. National Aquaculture Symposium.	May-Sept 2018
Aquaculture to become a growth sector in the economy	Effective collaboration between government, State agencies, industry, and farmers	**FD, CFTDI, IMA, AQUATT**	Liaise with farmers and meet and finalize comprehensive training programme for new entrants, existing producers and potential farmers for selected species.	June 2018 to Sept 2019
Fast-track slow development pace in the industry	Accelerating innovation and production	**AU, SFC, IMA,CFTDI**	Formulate appropriate prioritization of production systems and species for successful commercial projects, inclusive of business models. Training, Extension, Fish Health Management. Food Safety	Jul 2018 to Sept 2020
Formation of National Aquaculture 'Hub'	Harnessing available skills	**FD, AU, CFTDI, IMA, SVMUWI, SFC**	Upload relevant material in single space for easy access to information. Collect geo-referenced data on all farms and projects for spatial database planning and management and improve existing Internet and social media platforms with appropriate links internally and internationally	May 2018 to Dec 2018
Build capacity and scale in the industry	Public-sector private partnerships (PPP)	**FD, IMA, InvesTT, SFC**	Promote aquaculture as a viable business with entrepreneurs and business people to better access private capital and human resources.	May 2018 to Sept 2020

Increase Marketing	Appropriate marketing initiatives	**FD, CFTDI, SFC**	Increase Marketing, processing and value-added component to all products and empower consumers in available choices.	Oct 2018 to Sept 2019
Develop Sector	Scaling-up of operations.	**AU, IMA, SFC, SVMUWI, CFTDI**	Formulate appropriate policies and industry specific legislation. State stakeholders to provide best management practices manuals for the species cultured and methods of appropriate post-harvest handling and food safety.	Oct 2018 to Sept 2022

Figure 3. Simplified Conceptual Framework for Aquaculture in Trinidad and Tobago



National Aquaculture 'Hub'

This network creates the opportunity to develop a **National Aquaculture 'Hub'** under one Ministry, the Ministry of Agriculture, Land and Fisheries for all aspects of aquaculture in order to satisfy the growing requirements of a needed industry towards national food security, food production and generation of sustainable aquaculture and related businesses. This will be responsible for demonstration projects as well as the driver for future practitioners of next-generation aquaculture businesses, integrated rural and urban farming in Trinidad and Tobago. It will also improve cooperation and collaboration and remove duplication.

6. Conclusion

There has been much discussion with industry stakeholders including various government and State agencies, active producers, industry personnel, end-users and potential farmers. While the plan emanates from the Ministry of Agriculture, Lands and Fisheries, it has incorporated the invaluable feedback received from key government partners and private individuals and will reflect the needs of these stakeholders. It will be a work in progress as we reboot the developmental process to discard the unworkable models, keep and embrace the success stories, adopt innovation when it is successful and face the challenges ahead. It will take continued teamwork and dedication for a national success story in aquaculture development and it will also take time to fulfil our objectives towards a sustainable aquaculture future.