CONTRIBUTION 1.4

Inventory of Marine Fish and Aquaculture Factory Processing Establishments in CRFM Member States

Sandra C. Grant*, Adele Ramos, June Masters, and Pamela A. Gibson

Caribbean Regional Fisheries Mechanism Secretariat, Belize.
E-mail: sandra.grant@crfm.int, communications@crfm.int, june.masters@crfm.int, pamela.gibson@crfm.int*

Abstract

To understand the factory fish processing industry in the Caribbean, the CRFM/CARICOM Fisheries and Aquaculture Priority Commodity Working Group (FISHCOM WG) developed tools to gather information on the industry to: (i) generate a listing of processing establishments in the CRFM Member States with contact information; (ii) understand the nature of their activities (what they process, type of processing/value-addition, level of trade); and (iii) identify challenges and opportunities experienced by fish processors. Data collection and assessments were done between April and August 2022, and all analyses were performed using IBM SPSS Statistics 26.

Altogether, 216 marine fish and aquaculture factory processing establishments were identified: 179 marine fish processors and 37 aquaculture processors. Generally, fish factory processing establishments in CRFM Member States were involved in processing and preparing frozen whole/fillet fish and chilled fresh fish. They provide diverse goods and services ranging from purchasing varied species of wild-caught marine fish from fishermen, fresh aquaculture products from farms, or frozen imported fish, to processing and selling on the domestic and/or export markets.

Networks and communication are key to strengthening the processors group. The CRFM developed a webpage with a Contact Management System for Processors, which will allow processors and other interested parties to search for information and develop networks between individuals/countries. Also, the CRFM/IICA Fisheries Food Safety Hub was developed to strengthen the SPS capacity in the fisheries sector across the Caribbean. The Hub has over 100 documents including manuals, PowerPoint presentations, videos, and other items on health checks and certification, capacity building resources across the value chain, and general information on food safety.

KEYWORDS: factory processors, fish commodities, trade

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1. INTRODUCTION

Marine fish and aquaculture contribute to improved livelihoods and health, potentially contributing to several Sustainable Development Goals (SDGs), including reducing hunger and poverty, by making fish available and affordable to the poor. In 2020, fisheries and aquaculture production totalled 214 million tonnes, with an estimated value of USD 422.3 billion: Aquaculture accounts for 57% of total production (FAO, 2022). In the CARICOM/CRFM region that same year, the total number of marine fishing vessels was estimated at 32,128, producing approximately 132,267 tonnes of fish valued at USD 435 million. This was the lowest production since 2011. The decrease in production was due to the impacts and restrictions imposed to address the COVID-19 pandemic. The 41 vessels on open registers fishing on the highs seas produced 160,711 tonnes. Also, in 2020, aquaculture produced 7,798 tonnes of mainly tilapia fish and shrimp products valued at USD 41.15 million. Over 472,212 people were engaged in the fisheries and aquaculture sectors, of which 15% were women. When considering the fisheries value chain, such as processing or marketing, women accounted for half of its workforce (CRFM, 2021).

The Caribbean Regional Fisheries Mechanism (CRFM), as the regional fisheries body of CARICOM, is responsible for leading the work on development of the marine fish and aquaculture industries as priority commodities, through the CRFM/CARICOM Fisheries and Aquaculture Priority Commodity Working Group (FISHCOM WG). The Working Group is charged with developing and overseeing implementation of the Fisheries and Aquaculture Priority Commodity Strategy and Action Plan and working with governments and industry partners towards reducing the region's fish import bill, which in 2020 was valued at USD3.955 billion. The Working Group prepared an inventory of all national and regional projects/ initiatives that are focused on marine fish and aquaculture commodity development (CRFM, 2022). This was done to ensure that the FISHCOM WG provides a comprehensive communication and collaboration network with relevant agencies and initiatives undertaking marine fish and aquaculture commodity development work. It is envisaged that the FISHCOM WG network, will facilitate sharing of lessons and best practices, and by this means, also facilitate a knowledge exchange system, adaptive learning, and hence optimization of the benefits expected for the CRFM and CARICOM memberships. A gap identified was the lack of knowledge and information on marine fish and aquaculture factory processing establishments in the region.

The Food and Agriculture Organization of the United Nations (FAO) identified two processing streams: (i) small-scale fishers who often practice low-cost technology involving smoking, sun drying, and salting using traditional methods; and (ii) factory plant (https://www.fao.org/flw-in-fish-value-chains/value-chain/processing-storage/en/), the latter of which is the focus of this paper. Factory fish processing plants convert fresh or frozen fish into various types of products like smoked, dried, and canned products. These plants must meet high international standards of hygiene and food safety controls. Also, it requires modern technology, with environmentally friendly and efficient facilities. Plants use freezing methods such as blast freezing, plate freezing, immersion, or spray freezing to increase the shelf life of fish. As a first step, the FISHCOM WG sets out to understand factory processors in the region. In this paper, we present the results of our work to develop an inventory of factory fish processing establishments in CRFM Member States.

2. METHODS

To understand the factory fish processing industry in the Caribbean the CRFM Secretariat developed tools to gather information on the industry to: (i) generate a listing of processing establishments in the CRFM Member States with contact information; (ii) understand the nature of a of their activities (what are they processing, type of processing/value-addition activities, level of trade); and (iii) identify challenges and opportunities experienced by fish processors. Data collection and assessments were done between April and August 2022, and all analyses were performed using the IBM SPSS Statistics 26.

2.1 Internet search on Fish Processing Establishments

During the period April to July 2022, a master list of marine fish and aquaculture fish processing establishments was developed. A Microsoft Excel spreadsheet was designed to collate information on fish processing establishments in CRFM Member States. One document was developed for marine fish processing plants, and another for aquaculture processing plants; each of the files had separate sheets for each Member States. The headings for information collected to be sorted included: Country, Company, Contact first name, Contact last name, Contact job title, Business address, Business number, Facebook page, Other social media, WhatsApp contact, Email address, Food safety standards, Import/Export/Local distributor, Type of fish processed, Completed questionnaire, and Comments.

Information on marine fish and aquaculture processing establishments was obtained through: (i) conducting targeted Google searches (Websites, Facebook, Instagram, etc.,) on the companies identified; (ii) canvassing fisheries authorities for relevant local knowledge; and (iii) reviewing CRFM contact databases. One hundred and seventy-nine marine fish processing establishments and thirty-seven aquaculture processing plants were identified. The information was later uploaded to SPSS for further analysis.

2.2 Online Questionnaire

After the master list was completed, the CRFM Secretariat designed an online questionnaire to complement the information on the master list. An introductory letter and survey link was sent to all business on the master list with an email address (about 54% of establishments received emails). Where WhatsApp numbers were available, the introduction letter and survey link were sent (about 35% of entries had WhatsApp). About 83% of establishments on the master list had phone numbers. Each of these received 2-3 calls informing them of the project and inviting them to complete the survey. Each entity on the list was contacted at least twice either by email, WhatsApp or direct phone call, and they all of those that responded expressed preference for completing the survey online in their own time, instead of having an interview conducted. Of the 216 companies contacted, only 33 completed the questionnaire (15% response rate).

Of the 33 processing establishments that completed the online survey, five were selected for a follow-up discussion to the initial responses submitted, on their challenges/constraints to increasing export and reducing imports of fish and fishery products. The five companies included 1 large marine fish and aquaculture processing establishment, 2 medium size marine fish establishments, 1 small marine fish establishment, and 1 small aquaculture establishment. The interviews were conducted between July – August 2022 via WhatsApp. Issues related to technology level, infrastructure, freezer technology, waste products, downstream processing, value addition/preparation, intra-regional trade, packaging technology, investment, policy engagement, product supply/demand, sustainable fisheries/ecosystems, traceability system, and transportation were discussed.

3. RESULTS

3.1 Master list of marine fish and aquaculture factory processing establishments

In total 216 marine fish and aquaculture processing establishments were identified. The main processing activities were 179 marine fish processors and 37 aquaculture processors (***Figure 1***). Of the 17 Member States, no processing establishments were in Anguilla and Montserrat. Depending on the level of their aquaculture development, some countries only had marine fish processing establishments. In some cases, a processing establishment, processed both marine fish and aquaculture products.

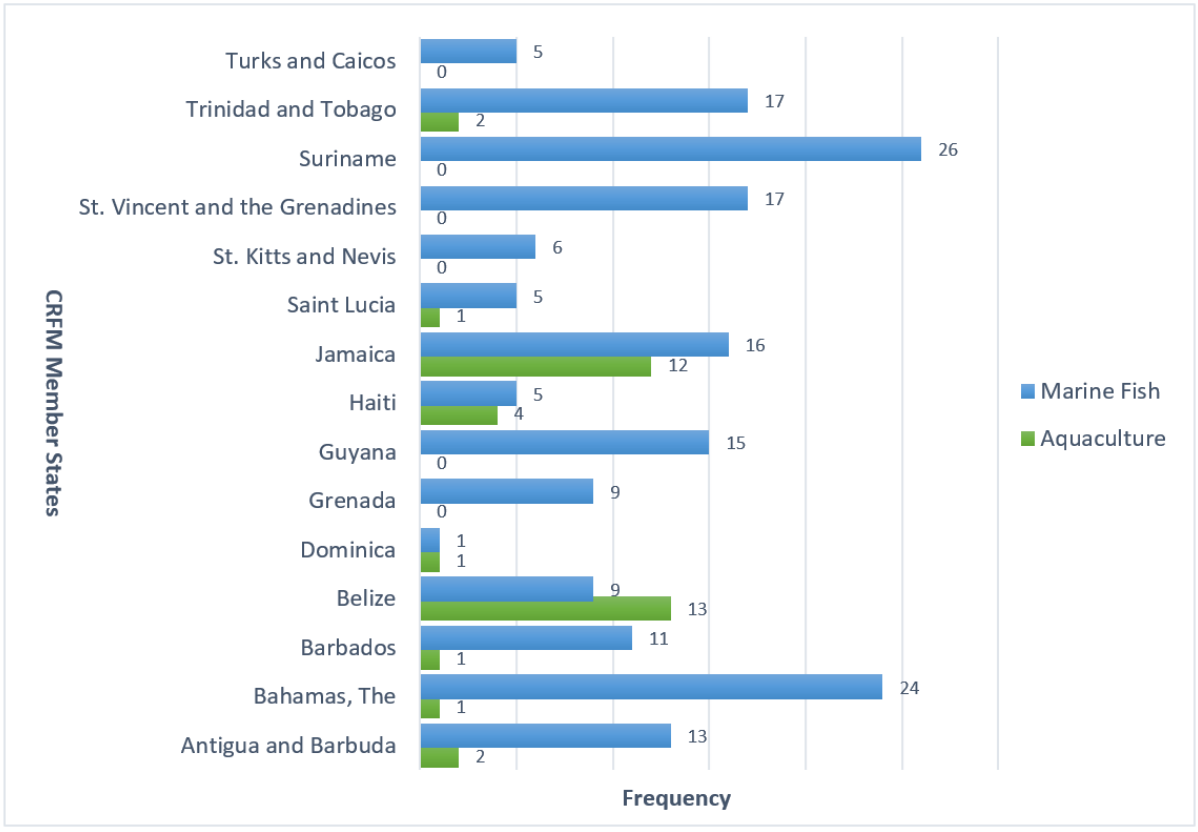

Figure 1. Country by type of factory processing establishments

Regarding food safety standards and their level of certification, information on social media revealed that 61% had some level of certification; However, some companies had more than one, and at times up to three different certifications (***Figure 2)***. The main certification was Hazard Analysis Critical Control Point (HACCP), a seven-step process which focus is to prevent potential physical and chemical, as well as biological hazards.

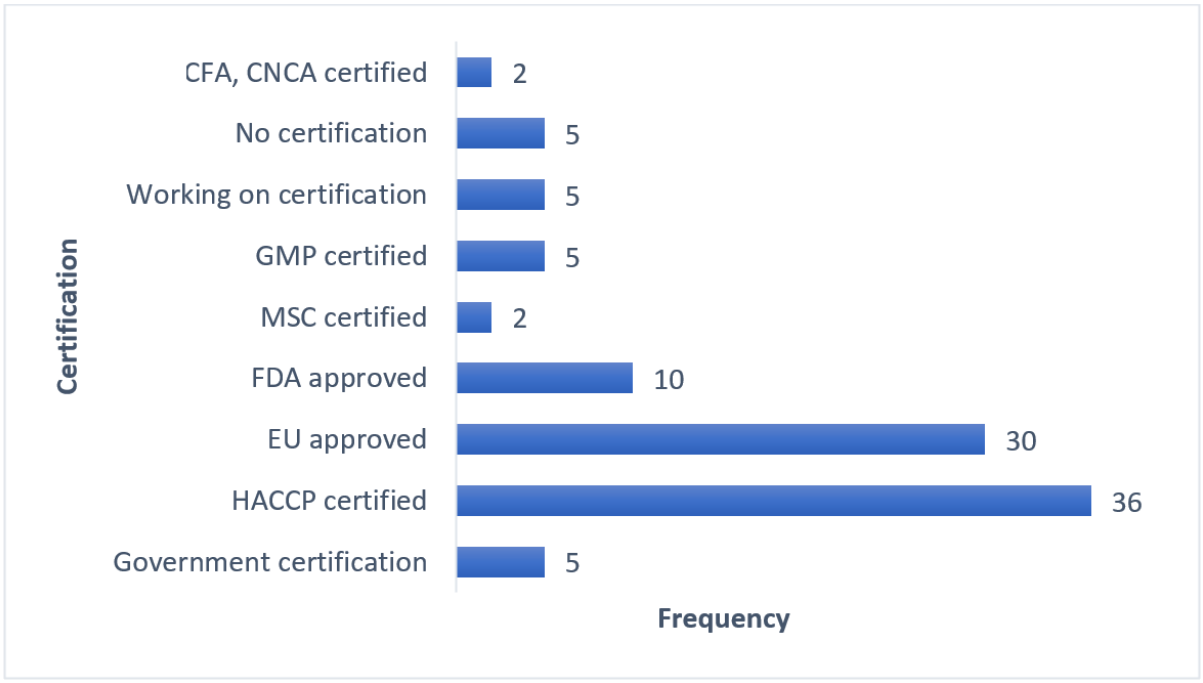

Figure 2. Level of food safety certification of processing establishments

Of the companies that stated their trade activities on social media (n=125), 62% of companies were involved in export, 13% import, and 25% domestic market (***Figure 3***).

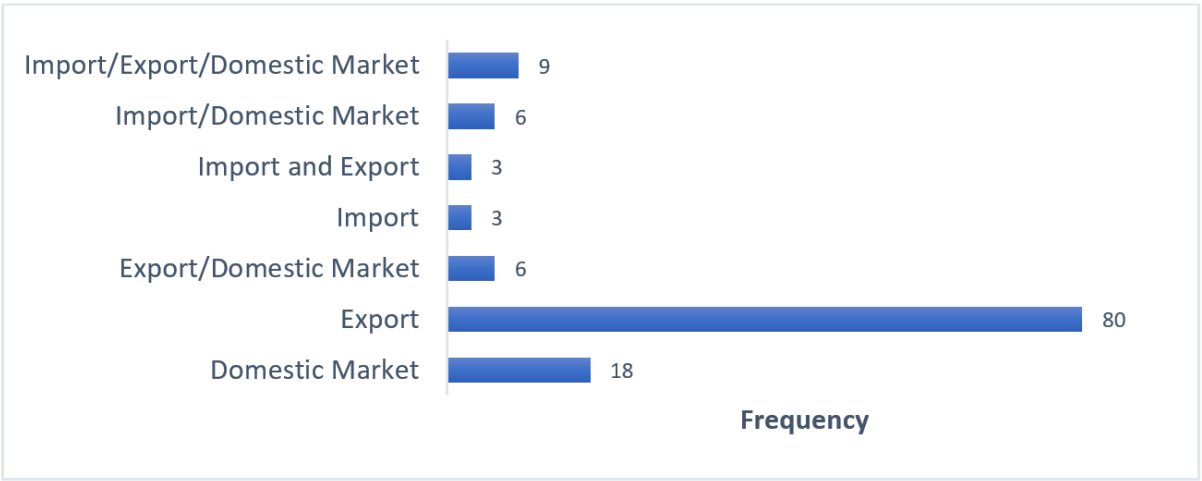

Figure 3. Trade of fish commodities (N=125)

The main marine and aquaculture species processed by country is listed below (***Table 1***).

Table 1. Country by fish species processed

Country	Marine Fish	Aquaculture
Antigua and Barbuda	Spiny lobster, finfish	Tilapia, Prawn, crawfish
The Bahamas	Finfish (reef), lobster, conch, sea urchin, stone crab	
Barbados	Finfish (pelagic), lobster	
Belize	Lobster, crab, conch, finfish (reef), sea cucumber	Tilapia, shrimp
Dominica		Prawn, crayfish
Grenada	Finfish (pelagic), lobster, shrimp	
Guyana	Finfish (groundfish), shrimp, crab	
Haiti	Lobster, conch, oysters, crab	
Jamaica	Conch, lobster, sea cucumber, finfish (reef)	Tilapia
Saint Lucia	Finfish (pelagic), lobster, shrimp	Tilapia
St. Kitts and Nevis	Finfish (pelagic), conch	
St. Vincent and the Grenadines	Conch, finfish (pelagic), lobster	
Suriname	Finfish (pelagic, groundfish), shrimp	
Trinidad and Tobago	Finfish (pelagic, groundfish), lobster, shark, shrimp	Tilapia

3.2 Online Survey Results

Of the 216 processors in the master list, only 33 completed the online survey (15% response rate). These are listed by country below (***Figure 4***).

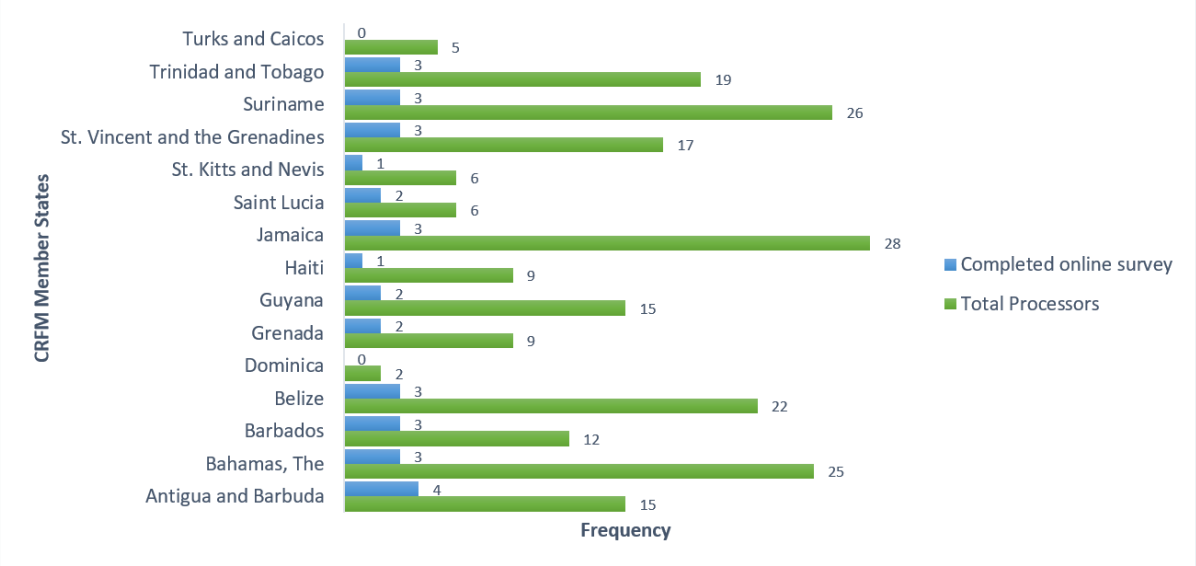

Figure 4. Total processors by country completed the online survey

When asked the size of their Processing Plant (total area (ft^2) or described as small/medium/ large), the response to this question varied in unit of measure. Based on the results we were able to estimate a range for small, medium, and large establishments. Of the 33 establishments sampled 41% were small companies with less than 5,000 ft^2 (***Figure 5***). These Plants produced from 1,000 lbs./month to 120,000 lbs./month depending on size of the Plant and type of fish species processed. Further analysis of volume of fish processed by processing plants is

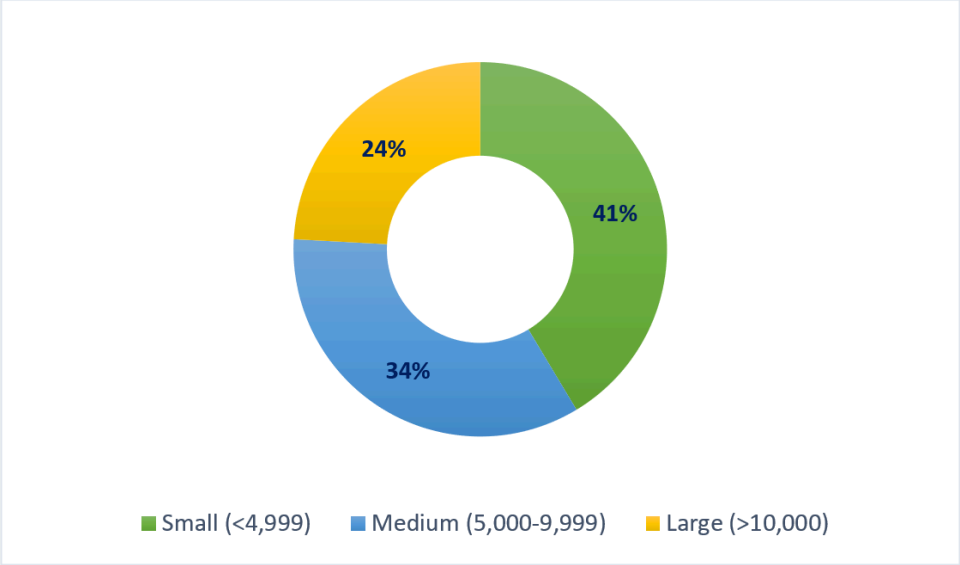

Figure 5. Percent size of factory processing establishment

Of the 33 processors, there were 10 aquacultures, 12 retail outlets, 1 aquaponics, and 26 marine fish processors. It was also noted that many processors were involved in a combination of activities (***Figure 6***).

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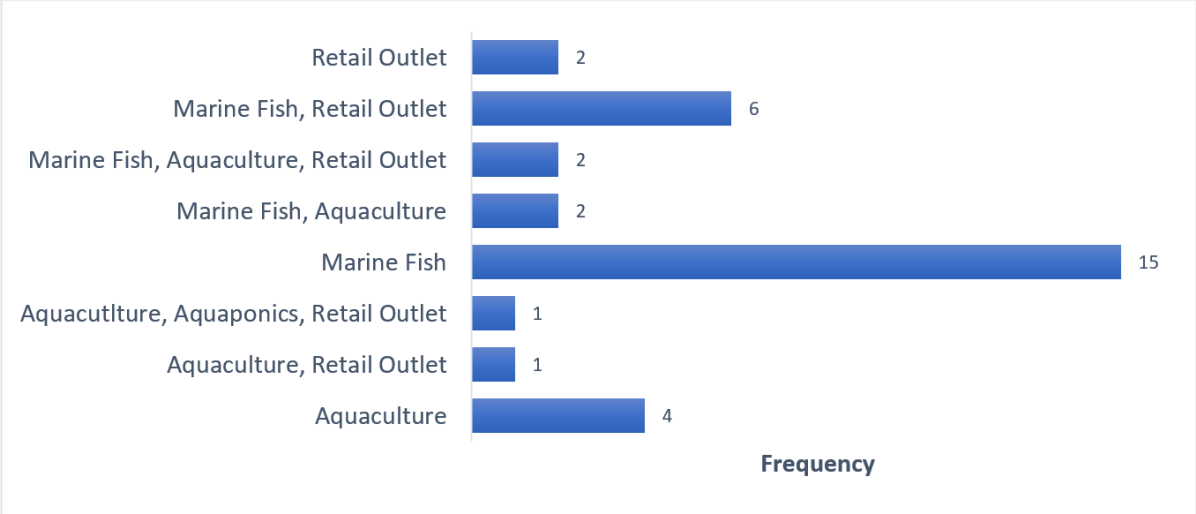

Figure 6. Type of combined processing establishments (N=33)

Of the 33 Companies, 50% were involved in processing only, while the others diversified their operations. See level of diversification in the list below (***Table 2***).

Table 2. Frequency of main fish processing establishment activities

Company activities	Frequency
Own aquaculture farms	2
Processing	17
Processing, imports	1
Processing; Distribution	1
Processing; Own aquaculture farms	2
Processing; Own aquaculture farms; Own vessels engaged in fishing and sell exclusively to Company	2
Processing; Own vessels engaged in fishing and sell exclusively to Company	2
Processing; Own vessels engaged in fishing and sell exclusively to Company; Sell to resorts and food stores;	1
Processing; Own vessels engaged in fishing and sell exclusively to Company; We also purchase from fish suppliers [middlemen] & fishermen;	1
Processing; Provides the facility for boat berthing, repairs, offloading; Sales; and Storage of fish	1
Processing; Sale (Retail/Wholesale)	1
Processing; Sales (Wholesaler/Retailer); Exporter	1
Package and retail	1

Of the 33 samples, 36% did not have certification. When further inquiry was made on why they did not attain certification, respondents shared their reasons.

- They needed guidance & governmental assistance.
- Lack of finance.
- High cost of implementation of protocols for certification. Lack of sufficient knowledge of the relevant certification standard. Lack of suitably trained staff to implement protocols and standards.
- Nothing is preventing certification it's just very complicated and not a requirement in CARICOM.
- Size of their business, and they wish to build a larger facility.
- Trained human resources, financial resources, inadequate infrastructure, lack of code of conduct, lack of disciplinary measures.
- They were trying to get all parties in place with assistance of the Bureau of Standards to conduct the evaluation and training.

Of the 33 respondents, the main marine fish commodities purchased for processing were finfish, spiny lobster, and queen conch. Tilapia and shrimp were the main commodities processed for aquaculture (***Table 3***). The finfish processed reflects the nature of the fishery in each country.

Table 3. Marine fish and aquaculture commodities processed by country

Country	Marine fish commodities processed	Marine finfish breakdown	Aquaculture commodities
Antigua and Barbuda	Spiny lobster		
Barbados	Finfish, spiny lobster, queen conch, sea urchin	Fish caught in fish trap as well as mahi-mahi, red snappers, flyingfish, barracuda, kingfish, tunas, sharks, swordfish, marlin, billfish, jacks, conger eel, crawfish, bonita, brims, lionfish	Tilapia
The Bahamas	Finfish, spiny lobster, queen conch, crab	snapper, grouper, yellowtail	
Belize	Finfish, spiny lobster, queen conch, crab, sea cucumber		Shrimp
Grenada	Finfish, spiny lobster, queen conch	yellow fin tuna, big eye tuna, albacore tuna, mahi- mahi, sailfish, swordfish, kingfish, marlin, wahoo	
Guyana	Finfish, shrimp, crab	Banga mary, butter fish, corvina, trout, kingfish, red snappers, snook, shark, croaker, catfish	
Haiti	Finfish, spiny lobster, queen conch, shrimp		
Jamaica	Finfish, spiny lobster, queen conch, shrimp		Tilapia
St. Kitts and Nevis	Finfish, queen conch, spiny lobster	Parrotfish, wenchman, angelfish, grunt (mixed fish trap)	
Saint Lucia	Finfish, spiny lobster, queen conch	All finfish available in our & surrounding waters, but not limited to - dolphinfish, kingfish, tunas including albacore, snappers, redfish, barracuda, jackfish, marlins, tuna, kingfish, fish from traps, etc	Seaweed
St. Vincent and the Grenadines	Finfish, spiny lobster, queen conch, crab	All permitted species, including mahi-mahi, wahoo, tuna and tuna-like species, marlin, sailfish, snappers and groupers, near shore pelagics (robin and jacks etc.)	
Suriname	Finfish, shrimp, crab	Sea trout, red snapper, grey snapper, mackerel, king mackerel, seatrout, golden corvina, yellow croaker, banga mary (king weakfish), grunts, silver snapper, grouper, cobia, Spanish mackerel	
Trinidad and Tobago	Finfish, spiny lobster, shrimp, crab	Caribbean red snappers, lane snapper, beeliner, grouper, croaker, shinner, beltfish, yellowtail snapper, queen snapper, tuna, shark, salmon, mahi-mahi, shark, all other local fish, tuna, marlin, sailfish, kingfish, wahoo, dolphinfish, Spanish mackerel, amberjack, Cavalli jacks	

Processors purchased products from diverse sources, whether, directly from fishermen (81%) or aquaculture farms and/or purchased from middlemen (52%) or at the fish market, and in some cases the product was imported (***Figure 7***).

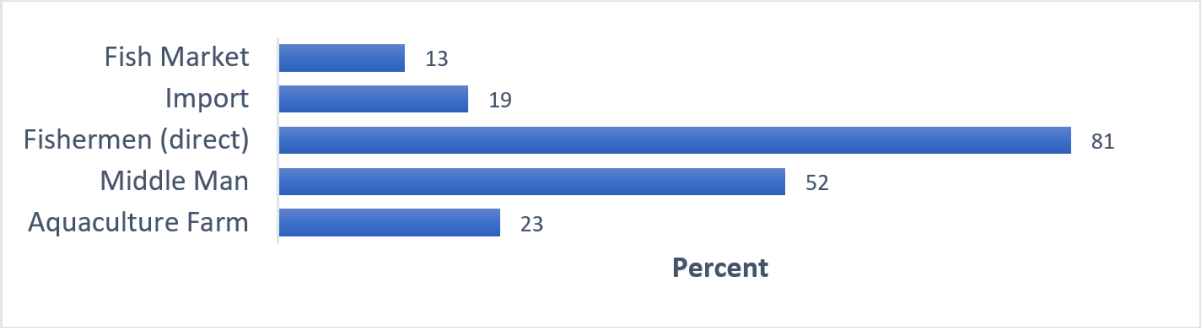

Figure 7. Source of fish purchased for processing

Fish commodities was mainly imported from the United States of America, China, Vietnam, Ecuador, and Chile. The main type of processed fish were frozen fish intra-regionally and extra-regionally (***Table 4***).

Table 4. Type of fish commodities imported by country

Fresh fish	Frozen fish	Smoked fish
St. Vincent and the Grenadines	Trinidad and Tobago, Guyana, Belize, Suriname	
	USA, Canada	USA
	China, Vietnam	China, Vietnam
	Ecuador, Chile, India	Ecuador, India, Chile

Respondents were involved in processing/preparing frozen whole/fillet (80%) and chilled fresh fish (77%). Although they also sold live and/or cooked lobster and smoked/dried/salted fish (***Figure 8***).

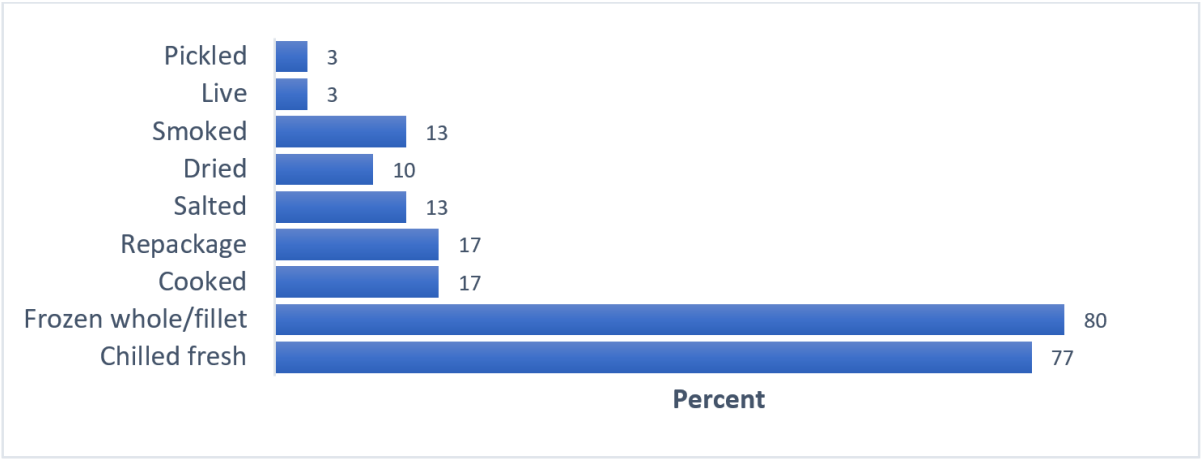

Figure 8. Fish processing/preparation methods utilized by processors

Fish products were usually sold on the export and/or domestic markets (Figure 9). About 45% of fish products were exported and 55% sold on the domestic market. The main counties/ regions respondents exported to were:

- CARICOM – Barbados, St. Kitts and Nevis, Antigua and Barbuda, St. Vincent and the Grenadines, Saint Lucia, Grenada, Trinidad and Tobago, Jamaica
- European Union – Netherlands, St. Maarten, Guadeloupe, Martinique, Spain, France
- United States of America, Canada
- China, Taiwan, Japan
- Australia, Mexico

The percentage exported varied by respondents; they estimated the following percentage exported:

- 100% North America
- 70% Barbados and the rest to St. Kitts and Nevis, Saint Lucia, St. Maarten, St. Vincent and the Grenadines
- 30% Canada, 20% Trinidad and Tobago, 20% Antigua and Barbuda, 10% St. Kitts and Nevis, 5% Tortola, 5% St. Maarten, 10% other
- 80% China
- 40% USA, 30% Caribbean, 20% Asia, 10% Europe
- 70% USA, 15% Belgium, 15% Caribbean

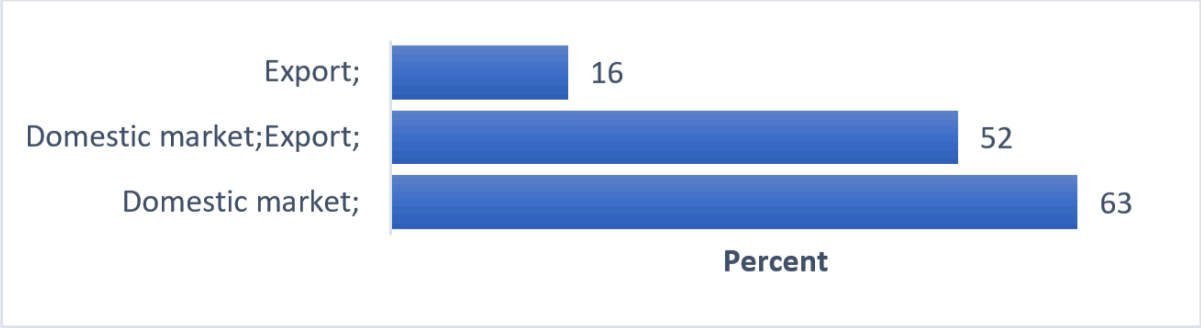

Figure 9. Percent sale of processed products

Generally, fish products were tested before exported (74%) (Figure 10). They are tested by Agriculture Health Authorities Inspectors, the Fisheries Department/Division/Authorities Inspectors, Government Veterinary Services, National Authorized laboratories, or the Company's private laboratory. Respondents who did not test their fish products claimed, either it was not necessary, or the required kits were not available; however, temperature checks and organoleptical inspections were carried out.

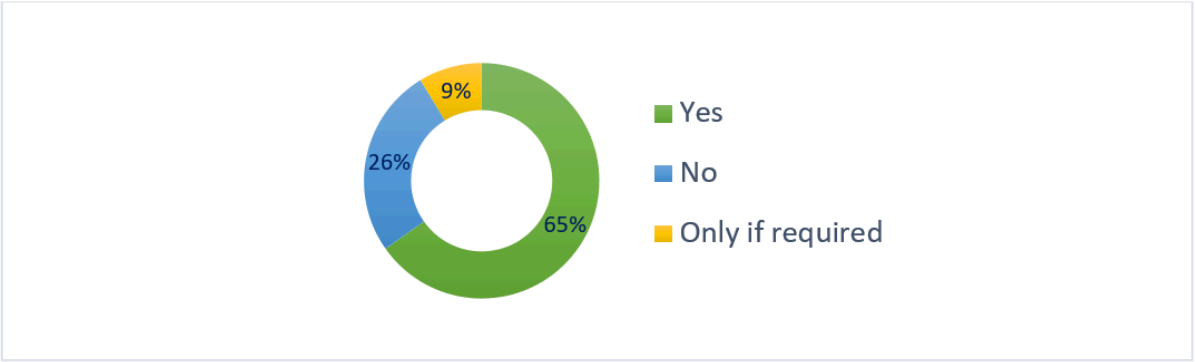

Figure 10. Percent of testing done on fish products for export

While 81% of companies provided training in fish food safety (Figure 11), the type/level of training received were from Government developed courses (35%), on HACCP (40%), and on food handling/safety (25%) (Figure 12).

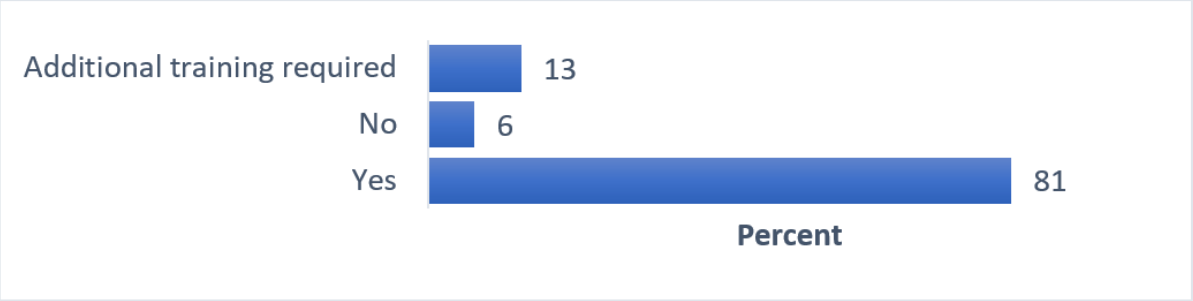

Figure 11. Percent of staff in processing establishments that received fish food safety training

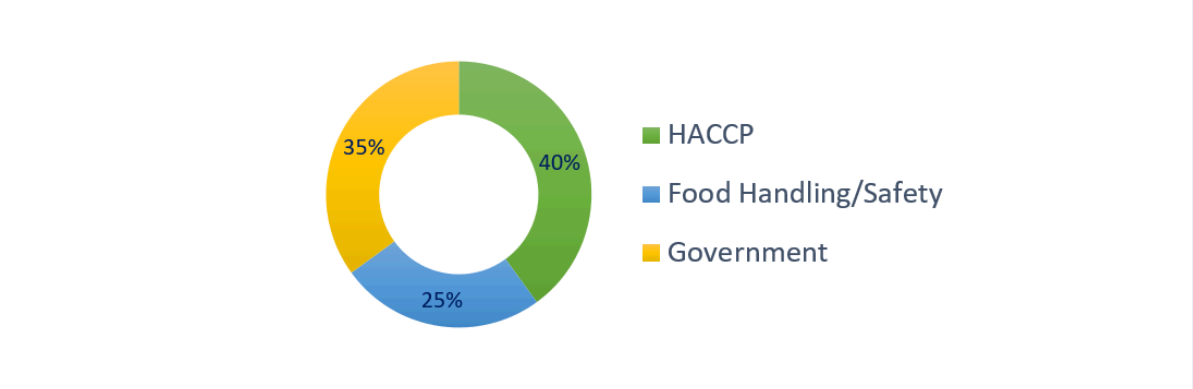

Figure 12. Percent of training type received by processors

3.3 Follow-up discussion on challenges experienced by processors

The online survey did not capture in detail the challenges/constraints experienced by Processors; Hence, an in-depth discussion on the challenges/constraints was conducted with Processors who were willing to participate. Below are the responses from five respondents who participated in the follow-up discussion, and the key challenges/constraints in their operations to increasing exports and reducing imports of fish and fishery products. It was noted that challenges varied by country, geographic location, size of company, and export. The main challenges noted were:

i. **Availability of raw material** – They lamented the reduction in fish catches over the past 20 years, and national fisheries governance that generally promotes sustainable management which applies management tools such as restriction of catch, quota/ total allowable catches, No Take Zones, etc., which restricts the ability to increase harvest. In some cases, they are only allowed to purchase specific quantities of fish product, while for others, the fish product was not available for purchase.

ii. **Transportation** – Since the COVID-19 Pandemic, processing facilities observed a

decline in frequency and reliability of marine transportation (merchant vessels) and airfreight to the region; particularly, intra-regional movement of fish product.

iii. **Outdated freezer technology** – Companies do not have the financial and/or technical capacity to upgrade/maintain their refrigeration system. Their systems have been operational 10-20 years with outdated technology and not energy efficient.

iv. **Cost of utility (water, electricity)** – The high cost of utility in the region increases the cost of operations and this has a bearing on a Company's ability to produce at a competitive price. For example, the cost of operations varied across the region. In Jamaica the cost of electricity (in USD) was 32 cents/KW, while in Belize it averaged about 22 cents/KW, and in St. Vincent and the Grenadines it was 42 cents/KW.

v. **Support from Government** – To increase export of seafood/aquaculture in the region, support from Government is required in several areas: policy and legislation; training and capacity building; and trade intra-regionally.

4. DISCUSSION

The survey response rate was 15% (33 of 216). Hence, we were not able to verify or provide additional information to the list of marine fish and aquaculture processing establishments as intended. However, we received responses from all CRFM Member States with factory processing establishments.

Small-scale fisheries and factory processing facilities are key to preservation of fish and income for Caribbean people, especially women. Factory processing establishments are a major national and regional player in processing, imports and export of marine fish and aquaculture products in the region. The inventory identified over 216 factory facilities which could be summarized as diverse in the types of goods and services they provide, from processing/retail, utilizing multi-species, source of raw material, domestic/import/export markets, and processing methods. While fish products are tested (65%), and they have workers trained in food safety (81%), more work needs to be done to ensure the highest level of food safety to meet international requirements or best practice.

Networks and communication are key to strengthening the processors group. The CRFM developed a webpage with a Contact Management System for Processors, where they will be asked to update the page with additional information (https://crfm.int/index.php?option=com_content&view=article&id=8). The web page will allow processors and other interested parties to search for information and develop networks between countries. Contact information included Country, Company Name, Business Address, Business Number, Facebook page, Other social media, WhatsApp Contact, and Email address. Periodic mail outs will be done to remind Processors that the Industry Directory is available and is available for use. The CRFM Secretariat is responsible for the maintenance of the Page.

Also developed was a SPS Fisheries Food Safety Hub to strengthen the SPS capacity in the fisheries sector across the Caribbean https://www.edfspscariforum.online/fisheries-sps-hub. The Hub has over 100 documents including manuals, PowerPoint presentations, video, and other items. It provides information on health checks and certification, capacity building resources across the value chain, and general information on production.

ACKNOWLEDGEMENTS

This research focusing on marine fish and aquaculture factory processing establishment was carried out thanks to the support of the CRFM/CARICOM Fisheries and Aquaculture Priority Commodity Working Group (FISHCOM WG) members from the CARICOM Secretariat, Caribbean Agri-Business Association, Caribbean Network of Fisherfolk Organisation, Suriname Seafood Association, Rainforest Seafood Association, Saint Lucia Department of Fisheries, St. Vincent and the Grenadines Fisheries Division, University of the West Indies, Caribbean Private Sector Organization, Caribbean Health and Food Safety Agency, Caribbean Fisheries Training and Development Institute, and CRFM Secretariat. We especially thank Abigail Masters and June Masters for collecting and compiling the information on processors. We are deeply grateful to all the processors who participated in the online survey and focus group meetings and who continue to engage with the CRFM. Special thanks to Adele Ramos for designing and publishing the Caribbean Fisheries Food Safety Hub and the Industry Directory on the IICA and CRFM websites, respectively. Also, to the Inter-American Institute for Cooperation on Agriculture (IICA) under the 11th EDF project for funding the Fisheries Food Safety Hub. We thank all the reviewers for their comments and feedback on the research and manuscript.

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Figure 10. Percent of testing done on fish products for export
Figure 11. Percent of staff in processing establishments that received fish food safety training
Figure 12. Percent of training type received by processors