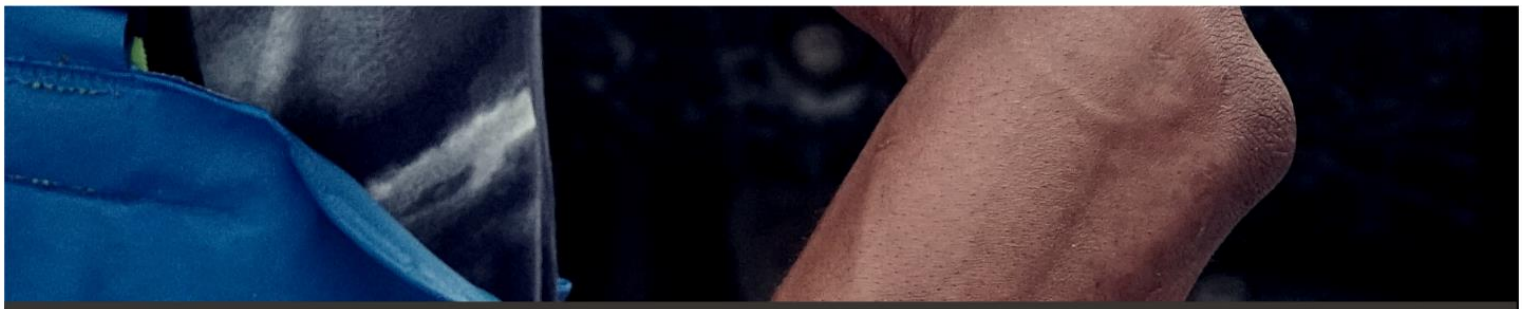

CANARI

BARBADOS MAHI MAHI VALUE CHAIN ANALYSIS REPORT

MARCH 2021

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CARIBBEAN NATURAL RESOURCES INSTITUTE

BARBADOS MAHI MAHI VALUE CHAIN ANALYSIS REPORT

Prepared by

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Abbreviations

BARNUFO	Barbados National Union of Fisherfolk Organisations
CARICOM	Caribbean Community
CPUE	Catch per unit effort
CRFM	Caribbean Regional Fisheries Mechanism
FAO	Food and Agricultural Organization of the United Nations
FD	Fisheries Division
FIP	Fishery Improvement Project
GDP	Gross Domestic Product
HACCP	Hazard Analysis and Critical Control Point
IUU	Illegal, unreported and unregulated fishing
MMABE	Ministry of Maritime Affairs and the Blue Economy
MSC	Marine Stewardship Council
MT	Metric tonnes, tonnes
NEI	Not elsewhere indicated
SWOT	Strengths, Weaknesses, Opportunities and Threats
VCA	Value Chain Analysis

Glossary

This glossary contains definitions of terms used with the Study. These definitions are not all-encompassing but are useful "working definitions" for the concepts outlined herein.

Actors: Persons (producers, wholesalers, processors, retailers) involved in getting the product from fishers to final consumer.

Aggregator: An intermediary who buys produce from many sources, pools it together and sells wholesale

Business service providers: Organisation (policy/regulations, research, extension, credit, market information) whose support enables products to flow from the landing site to the final consumer.

Industrial Processor: Processor registered as a seafood processing business who provides for the local and/or export market.

Artisanal Processor: Individual or groups of persons who informally engage in processing seafood for local sale.

Consumers: Individuals who use the final product at home.

Customers: Businesses that buy products from suppliers, and resell products to another business or to consumers.

Exchange Rate: The exchange rate is referenced as 1 US$ = BB$2.03 (Barbados dollar)

Fish Market: Retail market at a fish landing site that sells varied seafood products.

Live weight: The weight of finfish and mammals was the un-gutted weight; the weight of lobsters and echinoderms was the weight of the whole animal.

Restaurants: Formal or informal eating establishments that serve meals on a regular basis. This includes sit-down eateries and food trucks.

Value Chain Analysis (VCA): Assessing each part of the value chain to identify constraints and opportunities and seeing where improvements can be made, either from a production standpoint or a cost perspective, to improve profitability.

Vendor: A person who sells fish, retail, at markets or at landing sites.

Wholesaler: An intermediary who sells a large amount of produce to one or more buyers. The wholesaler may or may not have a single supplier. If they have multiple suppliers, they are considered aggregators.

Executive Summary

Mahi mahi (*Coryphaena hippurus)* was the second largest fish species in total fish catch for Barbados in 2016. It accounted for 24.5 percent of the catch. It was second to the four-winged flying fish, which is, traditionally, the largest contributor to fish catch, at 28.4 percent in that year. In Barbados, mahi mahi is normally caught using iceboats and longliners. Landings in 2018 were only 47 percent of the landings in 2009 and have been at low levels since 2010, relative to the historical catch, where landings reached a high of 2011 tonnes in 1988.

The mahi mahi fishery in Barbados is under significant threat from increasing numbers of juveniles being easily caught near floating sargassum mats. The increase in sargassum since 2011, due to climate change or other factors[1], is likely to further exacerbate this problem. Consumers have also been demanding the smaller-sized mahi mahi in recent years, as this is more affordable, and this behaviour has intensified as a result of limited incomes due to the COVID-19 pandemic. Furthermore, female vendors were disproportionately affected due to the pandemic, since they generally did not own a vehicle, and therefore could not engage in mobile sales to households. The COVID-19 pandemic has accelerated the growth of online, telephone, and mobile (WhatsApp) retail channels. Growth in these retail channels is expected to continue in the future.

Industry stakeholders unanimously agree that the fishery's sustainability is under severe threat, given the small landings of mahi mahi, and also because the quantity of landings have not recovered in recent years, and remains very low. In addition, while the global mahi mahi market is expanding, consumers in these markets are increasingly demanding traceability of the product as well as mahi mahi from sustainably-managed fisheries with needed certifications. Further, the Barbados mahi mahi fishery continues to show variability in its inter-year abundance, even with the increased landings of juveniles. The development of a minimum-sized regulation for the species is commendable, but this needs to be put into law to encourage less landings of juveniles. One significant strength of the mahi mahi fishery is the vibrant fisherfolk organisation, Barbados National Union of Fisherfolk Organisations (BARNUFO), which works closely with the private sector, government, and research and development agencies to provide training and policy support for fishers and vendors. In the first quarter of 2021, BARNUFO's members are expected to access health and life insurance through a new product by insurers Sagicor. This would provide much-needed livelihood support for fishers and vendors and their families.

In addition to promoting new systems by which vendors and processors can market their products locally, mahi mahi appears to have good market potential in the Caribbean Community (CARICOM) region, as this high-valued product is often utilised by the tourism sector, which was growing well pre-COVID-19, especially in countries such as Antigua and Barbuda. New value-added products, such as fish burger patties, fish fingers, and fish sausages have growing international appeal as consumers look for healthier food options. As the local and regional tourism sectors recover in the short to medium term, hoteliers and restaurant owners should be targeted for new business opportunities.

Overall, therefore, key recommendations are as follows:

1. Limit harvest of juveniles through legislation

[1] https://www.cavehill.uwi.edu/cermes/projects/sargassum/home.aspx#:~:text=Since%202011%2C%20huge%20volumes%20of,Caribbean%20coastal%20socio%2Decological%20systems.

2. Conduct a stock assessment to determine the health of the stock
3. Intensify public education to alert fishers, vendors, other processors and consumers of the potential threat of increasing the use of juveniles
4. Increase public awareness on the long-tern negative impacts of consuming undersized mahi mahi
5. Provide vehicle and business-support loans for delivery and direct-to-consumer sales
6. Provide innovative financing mechanisms to de-risk the sale of seafood by fishers to potential markets with slow payment terms (hotels, etc.)
7. Conduct fisher assessments to determine reasons for reduced trips for mahi mahi and drivers for targeting behaviour
8. Conduct market research on drivers of consumer behaviour to determine consumers' price sensitivity for local versus imported mahi mahi
9. Conduct research on the market segments (size, purchase characteristics, etc.) that should be targeted for increased online and direct-to-consumer sales
10. Provide training for all processors in the development of value-added products, such as fish sausages, burger patties and fish fingers for local and regional niche markets
11. In the short run, Barbados should explore CARICOM markets for mahi mahi export
12. Barbados should set up a Fishery Improvement Project (FIP) for the mahi mahi fishery
13. The fishery should pursue Marine Stewardship Council (MSC) certification, using a participatory approach
14. There should be much greater emphasis on utilising the trimmings from mahi mahi

1. Introduction

Fisheries in the Caribbean are considered small-scale and are largely artisanal, with limited motorised technology. In addition, many of these fisheries are largely open-access, multi-species complexes with varied regulations, enforcement, and data collection. However, the Caribbean region relies on the fisheries sub-sector either directly or indirectly as a source of protein, employment, and income.

In 2013, countries bordering or located within the Caribbean and North Brazil Shelf Large Marine Ecosystems (CLME+ region) adopted a 10-year Strategic Action Programme for the Sustainable Management of the Shared Living Marine Resources of the Caribbean and North Brazil Shelf Large Marine Ecosystems (CLME+ SAP). The CLME+ SAP aims to contribute to the achievement of the regionally-adopted long-term vision of "a healthy marine environment in the CLME+ that provides benefits and livelihoods for the well-being of the people of the region."

In support of this vision, the United Nations Food and Agriculture Organization (FAO) is implementing the Global Environment Facility (GEF) funded "Developing Organizational Capacity for Ecosystem Stewardship and Livelihoods in Caribbean Small-Scale Fisheries (StewardFish)" project. StewardFish is aimed at implementing the CLME+ SAP within seven Caribbean Regional Fisheries Mechanism (CRFM) Member States (Antigua and Barbuda, Barbados, Belize, Guyana, Jamaica, Saint Lucia, St. Vincent and the Grenadines) by empowering fisherfolk throughout fisheries value-chains to engage in resource management, decision-making processes and sustainable livelihoods, with strengthened institutional support at all levels.

StewardFish is being executed by five regional partner organisations—the Caribbean Natural Resources Institute (CANARI), Caribbean ICT Programme of the University of the West Indies (UWI-CIRP), Centre for Resource Management and Environmental Studies of the University of the West (UWI-CERMES), the Caribbean Network of Fisherfolk Organisations (CNFO), the Caribbean Regional Fisheries Mechanism (CRFM) - fisheries authorities (national executing partners) and fisherfolk leaders from the seven project countries.

Food and nutrition security are addressed throughout StewardFish, but it is tackled directly in Component 3 of the project which, in part, focuses on the enhancement of fisheries value chains. This incorporates getting better quality seafood to a wider cross-section of the population in each country in the region, through school feeding programmes and other initiatives.

One of the key activities under CANARI's work for StewardFish is to undertake a participatory analysis of fisheries value-chains to map opportunities for additional marketing and distribution of current and new seafood products, especially consistent with childhood nutrition. These analyses were conducted in Barbados, Jamaica, and St. Vincent and the Grenadines for the following fisheries: mahi mahi (Dolphinfish), Caribbean Spiny Lobster and Queen Conch, respectively (refer to methodological framework at Appendix 1 to see how the three value chains were selected). The value chain analyses will contribute to achieving Output 3.1.2 of StewardFish, which is "Use of local fish in healthy diets promoted through public policies and private enterprises".

This report presents the key findings and recommendations of the participatory value chain analysis (VCA) that was conducted for the mahi mahi fishery in Barbados.

1.1 *Objectives of the value chain analysis*

Fisheries value chains are the full range of activities in commercial capture fisheries. They start from harvesting fish, through adding value by processing and marketing, to delivering seafood to consumers. VCAs can guide both environmental management and fishery development within the context of the ecosystems approach to fisheries (EAF). In this regard, a participatory VCA should consider the institutional environment in which fisheries value chains operate (**Figure 1**) and may consequently be enabled or constrained; gender dimensions, particularly the role of women and youth in all levels of fisheries value chains; and regional and global challenges which are likely to have or are having direct and indirect impacts on developing climate-resilient and sustainable fisheries value chains and on food and nutrition security in the Caribbean.

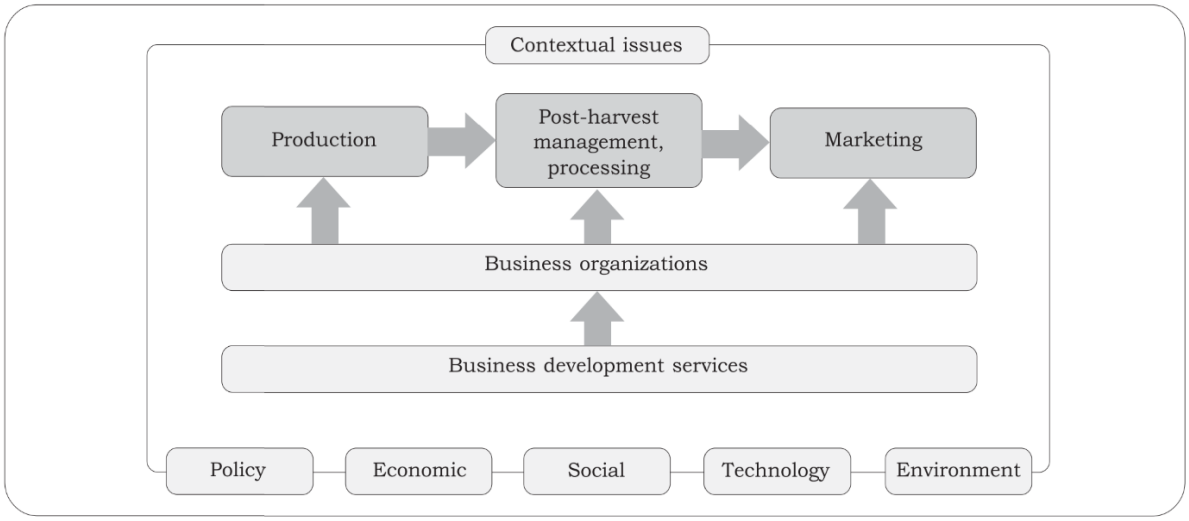


FIGURE 1: VALUE CHAIN AND BROAD INSTITUTIONAL SUPPORT

The ***specific objectives*** of the VCA for Barbados's mahi mahi fishery were to

- conduct a situational analysis of the mahi mahi fishery in Barbados;
- determine the impact of the mahi mahi fishery on artisanal fishers in terms of the level of employment and income potential;
- identify opportunities for increased added value of mahi mahi via the creation of new products or new markets;
- provide an overview of the stakeholder perception of the environmental sustainability of the fishery;
- assess the level of private sector involvement;
- assess the socio-economic frameworks that exist in the fishery, especially in terms of the network and role of actor groups; and
- provide policy recommendations to the government, local and regional technical and aid agencies and donors on how the mahi mahi value chain can become more sustainable for all actors.

2. Methodology

This study used a rapid assessment approach. Following the selection of the mahi mahi value chain for Barbados (refer to Appendix 1 for the detailed methodological framework describing the selection process), the authors conducted a preliminary VCA webinar with key fishing industry stakeholders on August 25, 2020 (refer to Appendix 2 for list of webinar participants). Webinar participants included representatives of fisheries-related state agencies, fisherfolk organisations, private sector (especially manufacturers of fishery value chain products) and academia with a role or interest in sustainable fisheries value chain development in Barbados. The specific objectives of the webinar were to

- outline the core concepts of a fishery value chain and how actors can benefit from using a participatory VCA;
- identify common goals for key actors in the mahi mahi value chain in Barbados;
- review a preliminary value chain for the mahi mahi fishery to verify main actors, links and product flow in this chain;
- identify gaps in the preliminary value chain and suggest new links and actors;
- identify existing and potential value-added products that can be developed for the mahi mahi fishery in Barbados; and
- discuss and agree on key market limitations and solutions, in achieving common fishery goals.

Following the webinar, additional desk study research, including interviews with some of the webinar participants and other stakeholders, was conducted (refer to Appendix 2 for list of interviewees). Stakeholder interviews were conducted via telephone to get additional market information on the actors in the mahi mahi value chain, their business operation, linkages, challenges and opportunities. The interviews sought to

- identify the actors at each step of the mahi mahi value chain, their task (harvest, trade, processing etc.), product flow and links to other actors;
- assess the resources, skills and capacities of fishery actors related to procurement of inputs and the key outputs produced;
- assess current coordination and institutional arrangements among actors;
- identify the local production and marketing linkages for mahi mahi and assess their relevance, adequacy, strengths, and challenges; and
- undertake sub-system characterisation:
    - analyse market access and the type of markets for each type of producer and intermediary;
    - analyse the market channels and how the channel choices are determined;
    - analyse which products or services will be delivered to which market;
    - analyse the key characteristics of the product or service that influences purchase behaviour;
    - analyse the number of stages in the channel (for example a fisher can deliver directly to final consumers or through intermediary partners, such as wholesalers or processors).

Due to time and financial constraints, key actor surveys (for consumers and fishers), could not be conducted to review consumer preferences for mahi mahi and other fish products.

2.1 *The value chain approach*

The VCA should show, at each level, the detailed key productive processes around the main products from the provision of inputs to harvest, harvesting, fish landing, marketing via wholesale, transportation, processing and retailing to final consumption. This involves the following:

- An estimation of costs, income and net margin for each stage of the value chains characterised
- Characterising the nature of value added in the value chain—safety and quality of the product; branding and labelling; social and environment norms, or sustainability standards
- Identifying the key requirements for market access through the value chain, such as bargaining power, market knowledge, technological proficiencies, infrastructure availability, and market orientation
- Identifying opportunities for increased value by forming new relationships, enhancing existing relationships, creating new products or by finding new markets for existing products
- Analysing possible risks fishers and other fishery actors may face in marketing and suggest possible ways to reduce or eliminate these risks

The value chain approach is oriented toward what customers and consumers want (Figure 2*:*). By analysing the value chain, information is obtained that should lead to better decision making by both those involved (including fishers and traders) and those wanting to support the value chain (such as policy makers and donors). This information is expected to result in higher and more sustainable livelihoods for those participating in the chain. Properly identifying the value share and risks of each actor in the chain allows these actors and policy makers to better coordinate activities along the chain, enhance weak links, and create links that may be missing. The VCA would allow actors in the value chain to focus their activities on products and services which will reduce costs, increase their income, use their limited resources (skill, money and capital) more effectively and hence provide more sustainable livelihoods. The VCA also allows the actors to better understand the needs of their suppliers and clients in the chain.

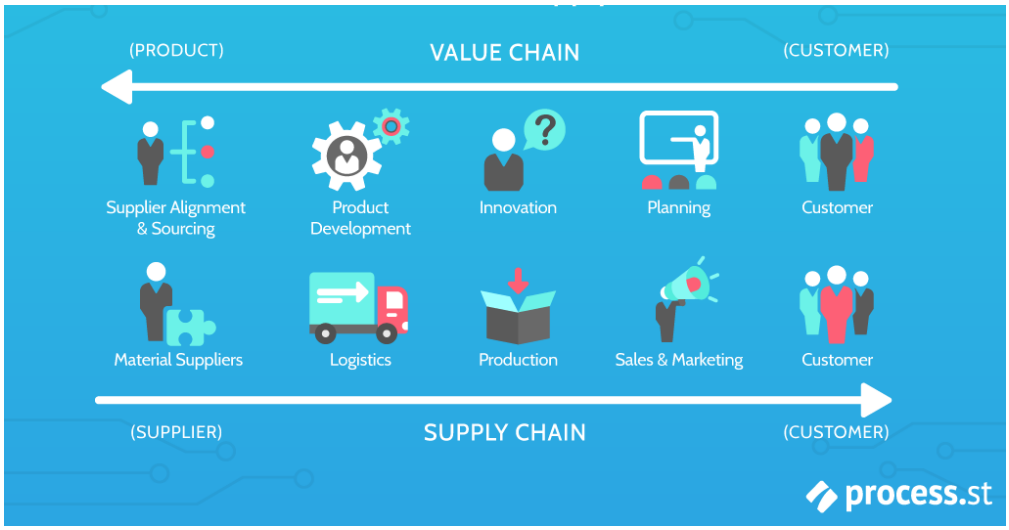


FIGURE 2: VALUE CHAIN VERSUS SUPPLY CHAIN (SOURCE: PETERSON, 2019)

Livelihoods in the value chain can only thrive and be sustained when the links to consumer wants are clearly established. Effective information flows from the market back to the various value chain actors will allow consumer 'wants' to better match what is supplied by the value chain. Consumers are usually willing to pay more for the added value (product, place, time, convenience) and this increases

profitability along the chain. Porter's value chain (**Figure 3**) below shows the division of activities between primary and secondary activities. The strength of each type of activity, together with its interaction with the other activities, helps to determine the size of value that firms can create or sustain.

FIGURE 3: PORTER'S VALUE CHAIN (SOURCE: PETERSON, 2019)

One key way to look at the fishery sector is as a flow of commodities from production (**Figure 4**) to final consumers. The first stage provides production technologies, inputs, management and information flows for sustained fish production and capture.

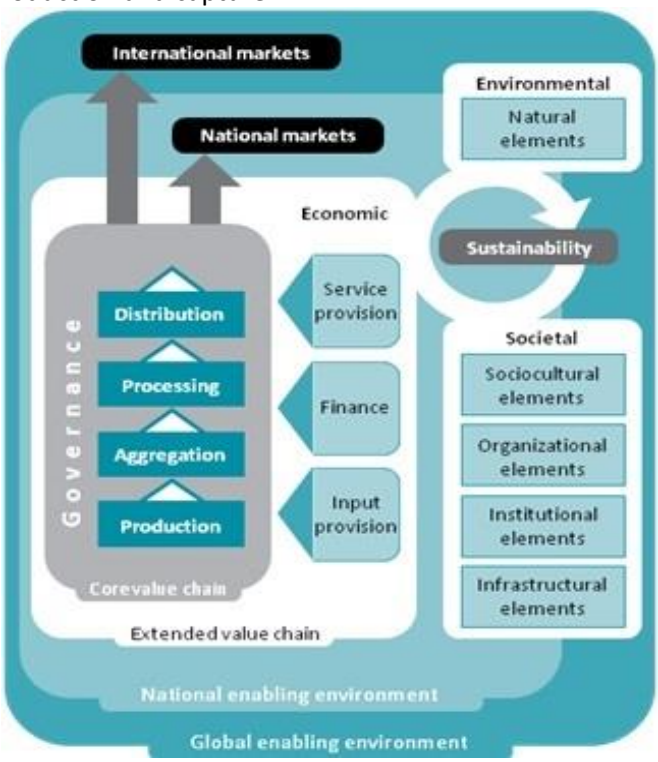


FIGURE 4: THE SUSTAINABLE FOOD VALUE CHAIN FRAMEWORK (SOURCE: FAO, 2014)

Four core functions (links) are distinguished in the chain: production (e.g. farming or fishing), aggregation, processing and distribution (wholesale and retail). 'Governance' refers to the nature of the linkages both between actors at particular stages in the chain (horizontal linkages) and within the overall chain (vertical linkages). The value chain requires understanding their complex environment and contains elements, such as information exchange, price determination, standards, payment mechanisms, contracts with or without embedded services, market power, lead firms, and wholesale market systems (FAO, 2014).

Promoting value added production leads to (Russell and Hanoomanjee, 2012)

- higher and more stable profits
- less consumer price fluctuations and product risk
- job creation
- diversification of products and markets
- more harmonious business operations via the targeted involvement of more secondary actors
- a strategic position to maximise overall fishery value

The key activities in the VCA for Barbados's mahi mahi fishery included:

1. **Mapping the Mahi mahi value chain**. This includes identifying all the stages and links in the value chain, to identify the flow of products, services, information and money. It identifies the volumes and value of the catch, how it is utilised, as well as past and current value-added products.
2. **Identifying the value chain actors**. This includes the main actors and the supporting actors and the composition of livelihoods that actors have in the chain.
3. **Identifying the services provided** by each actor in the value chain.
4. **Quantification of the value chain.** This involves providing information such as how many people are involved at each stage, product logistics, pricing, losses or wastage. The cost of activities (quantitative assessment) is outside the scope of this study.
5. **Qualitative assessment of the contribution** (including the share of value added) and the risks faced by each actor involved.
6. **Analysis of strengths, weaknesses, opportunities and threats (SWOT)**. The SWOT analysis identifies existing, emerging or potential threats to the operation of the value chain over the short, medium and long term. It also identifies opportunities to add value in the chain from the participation of new actors, the development of new products, new markets or new institutional arrangements or governance systems to support the activities in the chain.
7. **Market analysis.** This would focus on levels and trends in mahi mahi exports, export destinations and global market participation and growth.
8. **Providing recommendations** to improve the value chain.

3. Situational analysis

Barbados is located at latitude 130 10' N and longitude 590 35' W and is surrounded by the Atlantic Ocean. The total land area is 432 km^2 with a coastline of 95 km. The island has a small continental shelf of 320 km^2. However, its exclusive economic zone (EEZ) covers 177 346 km^2(FAO, 2015). The island had an estimated population of 287,025 people in 2019 (The World Bank, 2020). The Ministry of Maritime Affairs

and the Blue Economy of Barbados has primary responsibility for fisheries, mainly through the Fisheries Division and Markets Division. Total capture fisheries production changes significantly from year to year, mostly in response to the effect of sargassum seaweed over the last decade, which has considerable effect on flying fish catch (FAO, 2015). Domestic fish consumption, estimated at 40.1 kg per capita in 2013, is just over twice the global per-capita fish consumption for 2020. Barbados is a net importer of fish. In 2016, it imported 6,234 tonnes of fish for food, valued at US$23.3 mil. Of this chilled, fresh or frozen fish was 3,041.8 tonnes. Local marine capture fish production was 1,652 tonnes, valued at US$7.91 mil. Only223 t of domestically produced fish, worth US$0.6 mil. was exported that year (CRFM, 2018; 2020).

The fishing industry is open access, with multi-species fisheries and multi-gear vessels. There are approximately 30 fish landing sites around the island, categorised according to type of physical infrastructure and facilities as primary (markets), secondary (sheds) and tertiary (beaches). The majority of catches are landed at the primary sites and are often sold directly to consumers or fish vendors. In 2014, the largest proportions of the island's fish catches were landed at the Bridgetown Fishing Complex (64 percent), followed by the Berinda Cox Fishing Complex (16 percent), located in Oistins, in 2014.

In 2018, there were 2,200 persons directly employed in the marine commercial capture fisheries, and 6,600 persons employed in other fisheries dependent activities[2] (CRFM, 2020 p. 42). In addition, there was an estimated 1,146 fishing vessels operating in the commercial marine capture fishery. In general, the fisheries sub-sector in Barbados has high market potential because the local and global demand for fish is steadily increasing. Between 1980 and 2013, fish food supply in Barbados almost doubled, from 6.8 thousand tonnes in live weight equivalent, to 11.4 tonnes. In addition, fish is becoming a greater part of the national diet, as shown by the increase of fish per capita supply, which changed by 90 percent, from 21.1 kg/capita in 1980 to 40.1 kg/capita in 2013. As a result, fish accounted for a larger percentage of animal protein consumed [up from 18.2 percent in 1980 to 23.8 percent in 2013 (FAO, 2015)].

[2] These activities provide inputs and services to the fishery sector or occur as a product or service required along the mahi mahi value chain.

3.1 *Overview of the mahi mahi fishery*

Mahi mahi (Figure ***5***) was the second largest fish species to total fish catch in Barbados in 2016. It accounted for 24.5 percent of the catch. It was second to flying fish, which is traditionally the largest contributor to fish catch, at 28.4 percent in that year (MFEA, 2017). The stock status of mahi mahi (a.k.a. Dolphinfish or Dorado) (*Coryphaena hippurus*) in the Atlantic Ocean is stable, according to a 2016 Seafood Watch report. Population data for the Western Atlantic and Gulf of Mexico are outdated. The stock status is lacking for mahi mahi caught in the Indian Ocean and the rest of the Pacific Ocean, except for the United States, where it is assumed to be stable (FishChoice, 2020c).

FIGURE 5: MAHI MAHI (CORYPHAENA HIPPURUS)

3.2 *The mahi mahi fishery in Barbados*

Mahi mahi is harvested worldwide using a variety of gear: troll, rod and reel, purse seine, longline and handline (CBI, 2020). In Barbados, mahi mahi is normally caught using iceboats, and longliners. The characteristics of these vessels (Figure 7), along with the Dayboats and Moses boats which land mahi mahi are shown in **Table 1**. Ice boats operate in a multi-species, multi-gear fishery, and also land primarily flying fish (*Hirundicthys affinis*), shallow reef fish and coastal pelagics.

FIGURE 6: TYPICAL ICEBOAT USED FOR HARVESTING MAHI MAHI (SOURCE: MY GUIDE BARBADOS, 2020)

FIGURE 7: TYPICAL LONGLINER VESSEL, SOURCE: A&T MARINE LTD (2020)

TABLE 1: OVERVIEW OF FLEET USED FOR MAHI MAHI HARVEST IN BARBADOS

Fleet Characteristics	Moses	Dayboats (launches)	Iceboats	Long Liners
Number of Vessels	588 Vessels (2014)	230 Vessels (2014)	175 Vessels (2014)	41 Vessels
Vessel Length	3–6 m	6–12 m	>12 m*	12–24 m
Average Trip Duration	Less than 24 Hours	Less than 24 Hours	1 day–2 weeks	12–28 days
Crew	1–2	2–3	2–3	4–5
Additional Features	Open (un-decked), rowboats	Mostly wooden, fitted with a cabin	Cold storage (an ice box), 180–200 hp inboard diesel engines, navigation, communication and safety equipment	Fitted insulated ice hold, inboard engines, cabin, navigation, communication and safety equipment
Range	N/A	N/A	200 Miles offshore	400 Miles offshore
Primary Target Species	Reef Fish with mahi mahi as bycatch	Flying fish, Mahi mahi	Flying fish, Mahi mahi**	Tuna and Swordfish for export, Mahi mahi, Flying fish and billfish sold locally*
Gear/ Catch Method		Trolling or lurk lining	Trolling or lurk lining	Longline
Catch Share**	<1%	6.1%	81.7%	11.9%

Source: FAO Country Profile (2020); CRFM (2020, p. 22); *Oxenford et al (2019); **Estimated from 2007–2017 averages (Oxenford et. al. 2019).

Based on the fleet characteristics, the iceboats, dayboats and Moses boats comprise the artisanal mahi mahi fleet, while the long liners are industrial, since they require a much higher level of investment. Fishing effort directed at the large pelagics (overall) has increased due to an increase in the number of iceboats and the growth of the long line fleet. This indirectly provides potential increased fishing pressure on the mahi mahi, which is a medium-sized pelagic, as well as increased competition with the artisanal vessels, when mahi mahi has lower abundance.

The annual fishery production for Barbados between 2005 and 2016 shown in **Table 2**, shows significant variability, with values reaching a high of US$15.05 mil in 2013. The fisheries sector contributed 0.15 percent to gross domestic product (GDP) in 2016. Mahi mahi production showed large decline from the 2009 level (**Figure 8**), with only 47 percent of the 2009 landings, being recorded in 2016.

TABLE 2: ANNUAL MARINE CAPTURE FISH PRODUCTION (MEAT WEIGHT IN TONNES)

Year	Production	Production Value (US$ mil)	Fisheries Contribution to GDP (%)*	Mahi mahi production
2005	2182			
2006	1974			
2007	2391			
2008	3220			
2009	3467			870~
2010	3229		0.14	465.0^
2011	1773	7.20#	0.10	505#
2012	1300	5.90#	0.12	459.0^
2013	2735	15.03***	0.21	514.0**
2014	2153	11.86***	0.14	278.0
2015	1401.0^	6.86	0.13	373.0
2016	1652.0^	7.91	0.15	404.7^

[Source: Table 13, CRFM (2018); *Table 22, CRFM (2018), ** Table 17 CRFM (2015); ***Table 23 CRFM (2015), #CRFM 2014; ^MFEA (2017, p. 58)]

Mahi mahi is available throughout the year. From 1994, landings exhibited an obvious seasonality, with peaks in March and April, but from 2015 to 2017, this pattern vanished. Despite the significant decline in mahi mahi landings, the clear changes in catch per unit effort (CPUE) data, reflected in catch per trip, suggests changes in its inter-year abundance for the areas usually harvested by the fleet. In addition, since the CPUE did not show a declining trend from 1994 to 2017, this suggests that there were less trips (actual or reported) targeting mahi mahi (Oxenford, Johnson and Franks, 2019).

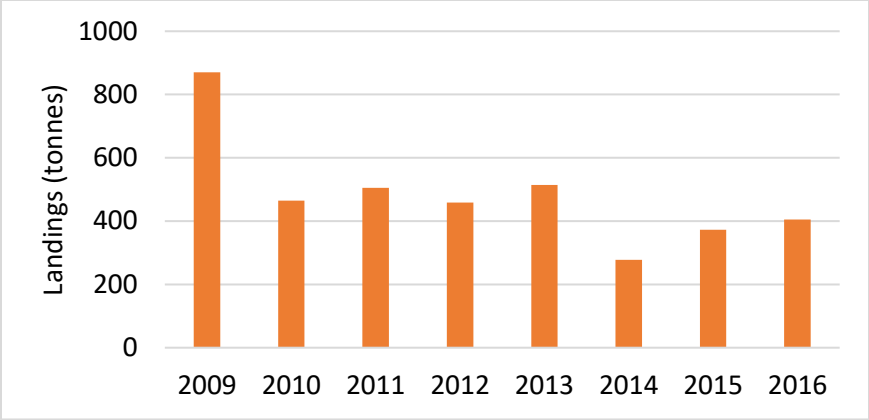


FIGURE 8: MAHI MAHI LANDINGS IN BARBADOS

In 2018, Barbados exported US$13,000 worth of fresh and frozen mahi mahi to the United States (Sustainable Fisheries Partnership, 2018, p. 14), which represented 0.0 percent of imports to that country by volume and value.

In 2018, Barbados was the leading producer of mahi mahi among CRFM Member States (see Error! Reference source not found.). However, Barbados's exports were 0.1 tonnes, the only exports recorded for this species for all CRFM member states (CRFM, 2020, p. 73). This occurred as a result of the high local demand for this species by locals, hotels and restaurants, in addition to poor access to export markets, relative to competitors, who may have lower production costs and premium branding.

TABLE 3: MAHI MAHI PRODUCTION (MEAT WEIGHT IN TONNES) OF THE MARINE CAPTURE FISHERY FOR 2017 FOR CRFM MEMBER STATES (SOURCE: CRFM, 2020)

A&B	BAR	BEL	DOM	GRE	MON	SKN	SLU	SVG	T&T
22.00	405.00		228.30	122.76	0.10	65.00	403.09	44.45	7.56

3.3 *Mahi mahi biology*

Mahi mahi's anal fins are sharply concave and their dorsal fins extend along the length of their body. Mahi mahi are normally found in open waters, but they are also found near the coast. It feeds mainly on fish, but also relies on crustaceans and squids. Spawning normally occurs during the summer (June to September) (FAO, 2020). They are found worldwide in tropical and subtropical waters warmer than 20°C (FAO, 2014). Mahi mahi typically live up to five years, grow quickly and get to seven feet (210 cm), and weigh more than 80 pounds. The average catch weight is 15 kg (33 pounds) for a 3 foot (1 m) long fish, however, schooling mahi mahi do not usually exceed 9 kg (20 pounds). They reach maturity in four to five months in the wild. Size at maturity varies worldwide. In the Eastern Caribbean, 50 percent of males and females mature at 91 cm and 83 cm. Males have a large bony crest on their forehead, while females, which are smaller than males, have rounded heads with no crest (Montery Bay Aquarium, 2013).

In the Atlantic, mahi mahi spawn under floating patches of brown algae called sargassum. Depending on their size, females release between 40,000 and one million eggs at each spawning event, which occurs every two to three days during peak season. Eggs and larvae are pelagic. Juveniles are recognisable due to alternating dark and light stripes along their body, which fade as they grow. Their brilliant blue-green and yellow colors fade to silver soon after they die.

Larval and juvenile mahi mahi feed primarily on crustaceans. Seabirds and fish, such as tunas, marlins, sharks, and swordfish, prey on mahi mahi (FishChoice Inc., 2020). Mahi mahi are a highly migratory species and are generally found near the surface at depths between 0 and 277 feet (0–85 metres) in offshore waters. Juveniles will form schools while older fish tend to be solitary. Females and small males can be found near natural and artificial floating objects including sargassum algae.

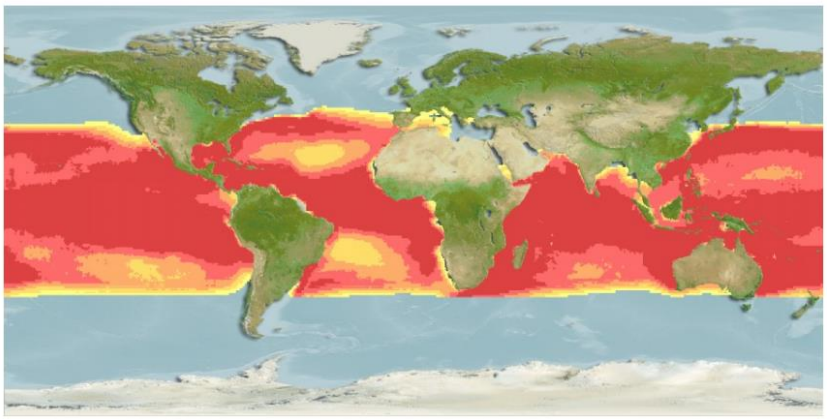


FIGURE 9: DISTRIBUTION OF MAHI MAHI*.

*Colour variation shows probability of presence, with mahi mahi more likely to be found in darker red areas.

Source: Figure 1 (Monterey Bay Aquarium 2013)

Mahi mahi are popular for both food (in the commercial fishery) and as game fish. Mahi mahi are also caught as bycatch in other fisheries such as marlin, tuna, sharks and swordfish (Greenpeace, 2020). It is a very popular game fish due to its beauty and fighting ability. They are fast swimmers, with an estimated top swimming speed of 50 knots (57.5 mph). Their fast growth make them able to withstand fairly high levels of harvest. Tens of thousands of tonnes of mahi mahi are delivered into the global market each year. The harvesting techniques pose more of a risk to other species, such as marine mammals, sea turtles, seabirds, and other fish species due to fishery bycatch.

3.4 *Mahi mahi preparation and nutritional value*

Mahi mahi is very low fat, has no carbohydrate or sugars and is very high in protein, as shown in **Table 4**. It is normally a firm, sweet meat, which is available fresh year-round.

TABLE 4: MAHI MAHI NUTRITIONAL VALUE (SOURCE: FISHCHOICE INC., 2020)

Nutrition facts	
Serving size: ***100 Grams***	
Amount per serving	
Calories	85.00
Total Fat	0.70g
Cholesterol	73.00mg
Sodium	88.00mg
Carbohydrates	0.00g
Protein	18.50g

4. Mapping Barbados's mahi mahi value chain

The value chain map (see **Figure 10**) shows distinct stages where value is added in the Barbados mahi mahi value chain. The key components, gaps and opportunities along the chain are elaborated in the following sections.

Inputs

The key harvest inputs are boats, engines, bait (Flying fish), fuel, motor oil, long lines or hand lines, ice and containers (ice boxes) to store the mahi mahi. Ice is produced and offered for sale at seven fish markets: Bridgetown Public Market, Berinda Cox, Consett Bay, Millie Ifill, Payne's Bay and Speightstown Fish Markets. Cold storage and chill storage facilities are provided at the Bridgetown Public Market, Berinda Cox Fish Market and facilities for cold storage are provided at Consett Bay and Speightstown Market. These inputs are normally readily available, but in December 2019, many vendors at the Oistins and Bridgetown markets indicated that their high mahi mahi prices (between BB$9–$10/lb.) were due to challenges in getting sufficient amounts of ice that they use to keep the fish fresh. Vendors pay BB$15 for ice daily, but with the shortage, this cost rose to BB$75 for ice from outside the market (Ellis, 2020).

Harvesting

Mahi mahi is normally caught by iceboats and longliners. A smaller number are caught using dayboats, with minimal catch by the Moses boats. It is caught using a hand line or longline. Key inputs for the iceboats are Flying fish for bait, 5 tonnes of ice (approximately BB$1,200) and diesel fuel for each trip. Based on mahi mahi production for 2016, the estimated catch share, by boat type and crew size (**Table 1**), 340 tonnes of mahi mahi are estimated to be landed by the artisanal fleet by 1,215 fishers. The latter uses the higher estimate for crew size (3) and assumes that the crew is unique to each vessel, which may be an overestimate if fishers operate on more than one vessel.

Even though the longliners predominantly target tunas, they also target mahi mahi, which accounts for 20–25 percent of their catch (Oxenford et al, 2019). Since 2011, with the influx of the sargassum, the dayboats have been capturing less mahi mahi, and less and less dayboats are being used over time. This may be happening in large part because the sargassum pushes the mahi mahi farther out from the shore, and the dayboats are not able to easily go farther out. The iceboats also have a much larger capacity than the Moses boats.

Over time, not only is the vessel composition changing, but fishers are also harvesting a different kind of fish mix. For example, more Amberfish or Almaco Jack (*Seriola rivoliana*) was caught with the influx of sargassum, than was previously caught. Consumers therefore started adapting to new species such as this one. For 2019 and 2020, the juvenile mahi mahi was 4–8 pounds, on average. Furthermore, in addition to lower landings over the past 10 years, they are also more variable, so this increases the fishers' risk in the fishery.

Key primary harvesting stakeholders are BARNUFO and the Caribbean Network of Fisherfolk Organisations (CNFO). BARNUFO is an umbrella fisherfolk organisation in Barbados comprised of five other site specific fisherfolk associations and two boat owner associations. It is also comprised of vendors and 100 plus fishers. BARNUFO benefits its members in many ways, including the provision of insurance coverage. Life insurance coverage for fishers, with agreed premiums, is now being provided by Sagicor Insurance Limited since October, 2020. BARNUFO, in collaboration with the Fisheries Division and other regional, international and local agencies, also provides capacity building for its members and is heavily involved in advocating for improved earnings and market access for members. The CNFO is the

umbrella organisation for national fisherfolk organisations throughout the Caribbean Community and advocates for training, sustainable management and adequate legislation.

Processing and value-added products

Mahi mahi is normally sold shortly after it is landed to vendors, who also engage in processing. These vendors gut and package the fish into 2-pound packages, for retail sale, mainly to households. Some boat owners who sell the mahi mahi retail, usually pay vendors in the market to gut and take the head off the mahi mahi before direct sales to households, hotels, or restaurants. This means that the vendors sell to households, but also take on the additional task of processing fish for some boat owners or fishers, who have their own clientele.

The supermarkets normally require fish to be vacuum packed, so the vendors are not able to access this market as they do not have the equipment to facilitate the required packaging. In addition, some supermarkets require traceability, and the small vendors are not able to provide this traceability as these systems are not established.

Vendors usually do not sell to hotels because these establishments usually make payments only after two or three batches of fish are delivered. These vendors do not usually have the cash to cover these lengthy payment delays, so this market option is not well established, despite the fact that hotels are potentially a high value market. The artisanal processors, because they have lower processing costs, are able to offer better prices to hotels, restaurants, supermarkets and households, versus the medium-sized processors. As a result, in recent years, some of the medium-sized processors have lost sales to these small vendors as a result of this advantage in the marketplace. These vendors and fishers sell to all the downstream value chain participants. The processors offer the following product forms: whole, gutted (bone-in) and fillet. Several of the vendors pay BB$5/fish for gutting services at the market.

There are also industrial processors that operate from processing plants. The processing plants often process fish products only and are Hazard Analysis and Critical Control Point (HACCP) certified. The deboning is normally done by women. The processors process locally-caught mahi mahi or whole, frozen imported mahi mahi. The latter act as competitors to local production, as they import mahi mahi and other fish species. Mahi mahi is processed into frozen steaks (95 percent of sales) and fillets. The steaks are sold to supermarkets, restaurants and hotels via delivery or pick up at the processing facility.

If local mahi mahi landings are low, the importers thaw the whole frozen fish to produce fillets. They also sell the whole frozen mahi mahi for BB$7/lb. to fishers, which is fixed throughout the year. They supply the national school feeding programme, which supplies primary and secondary school children with meals during the school term. Increasing levels of lower-priced fish imports crowded out the delivery of a fish burger (containing mahi mahi) directly to the school feeding programme. Currently, the school feeding programme utilises imported, lower-priced Whitefish (*Coregoninae* family), Bangamary (*Macrodon ancylodon*) and Butterfish (*Cephalopholis fulva*).

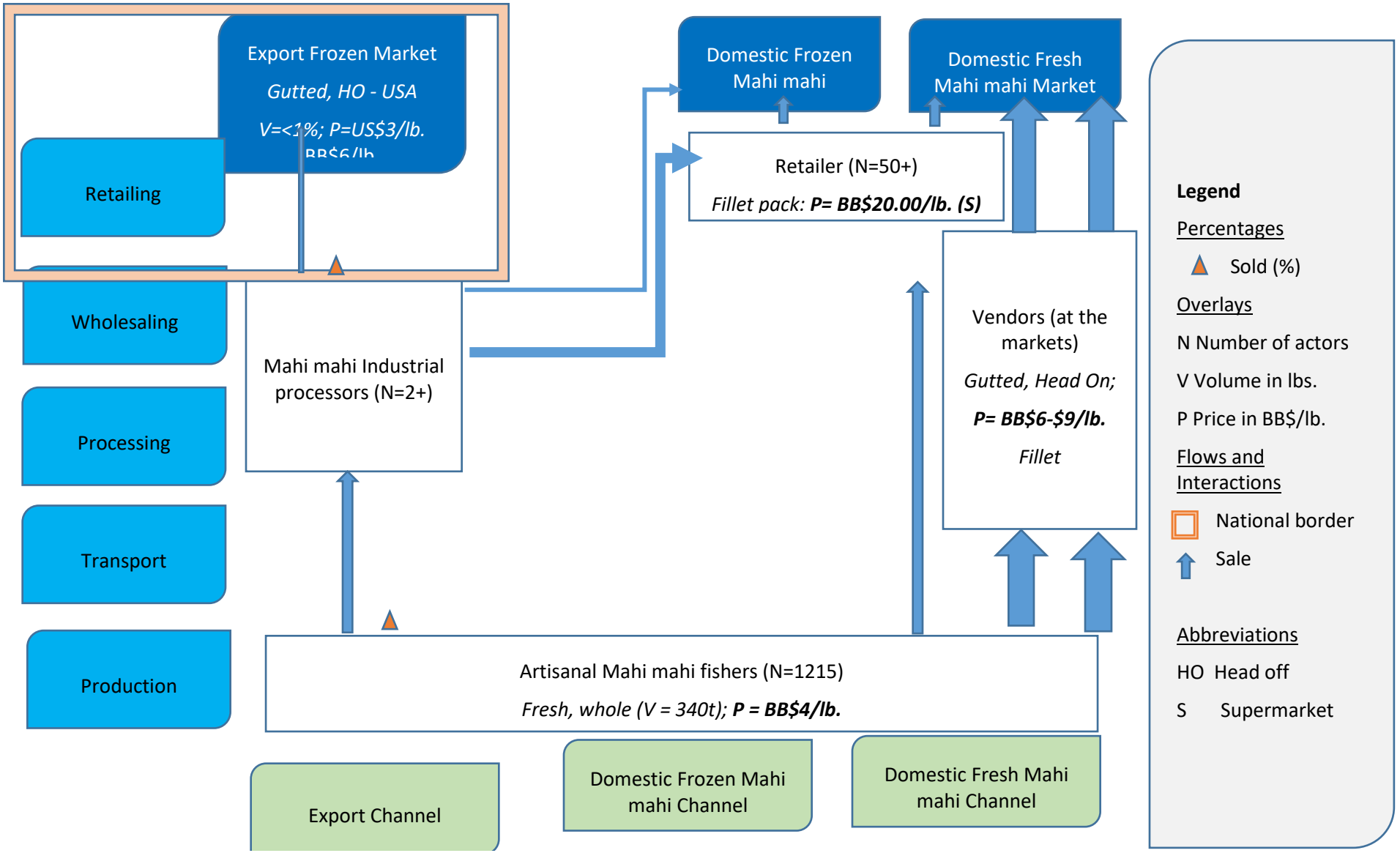


FIGURE 10: BARBADOS MAHI MAHI VALUE CHAIN MAP WITH PRICES

Value Added Products

Several mahi mahi products are sold in Barbados, based on locally-caught supplies. One key processor Morgan's Fish House provides

- Sides—sold as 1-pound package
- Portions—6-ounce package
- Mahi mahi fillet slices/top Loins—8-ounce fillet portions of mahi mahi are sold to restaurants and 1-pound retail bags for sale in all major supermarkets. These are sold mostly to hotels, large supermarkets and hypermarkets such as PriceSmart.
- Breaded mahi mahi fingers -10 fingers in a 400-gram package.
- Breaded 4-ounce mahi mahi burger patty, with up to 50 percent mahi mahi, sold four in a pack. These are sold to supermarkets, and up to June 2020, were being provided for the school feeding programme. The COVID-19 pandemic caused the cessation of this supply.
- Cold-smoked mahi mahi (smoked at a lower temperature than regular smoked products). The 198-gram package is sold to supermarkets, the 300-gram package goes to supermarkets, hotels and restaurants and larger blocks are sold to order.
- Mahi mahi sausages. This was exported to Trinidad and Tobago, but this market was lost as a result of COVID-19 (Mark Harris, Morgan's Fish House, personal communication).

Losses and Wastes

Two types of fillets are provided to consumers. In one kind, all bones, including the head and tail bones are removed. This fillet is normally sold at the supermarkets and hypermarkets. The second kind of fillet keeps the head and middle bone, but discards the tail bones. Only households choose the latter product. The bones are sometimes thrown away from the fillet process. Households have the option of receiving the head and tail bones in a separate bag (no extra charge), along with the fillet, and use these to add fish flavour to soups and other dishes. Some hotels use the bones to make fish stock. The pin bones are used as turtle food by the tourist recreational boats (catamarans) that operate day cruises or short excursions around the island.

No processors make fish-skin leather on a commercial basis. Only one processor is doing research and development for mahi mahi fish-skin leather, using environmentally safe dyes as an addition to the company's main products. However, they indicated that the variable and often low supply of mahi mahi would not allow fish leather production to be a commercially-viable stand-alone business. BARNUFO spearheaded a feasibility study reviewing the feasibility of making fish leather from mahi mahi on a commercial basis. It was found that it would not be financially feasible to pursue mahi fish leather, since it is expensive to process the leather due to the cost of the processing machinery and equipment. Additionally, chromium, a typical input in the process, needs to be disposed of carefully, and this is another deterrent in creating fish leather. Fish meal and other by-products were shown to be more viable.

There was a rendering plant that included mahi mahi waste products as an ingredient in the production of animal feed more than five years ago, but there is no information available on if this practice still occurs. Fish silage as a liquid fertiliser is also being developed for various fish species, but not necessarily for mahi mahi.

Aggregating and wholesaling

Data isn't readily available on if aggregation takes place in the mahi mahi fishery and the number of wholesalers for its fresh or processed form. These aggregators would normally buy fish or fish products

from multiple suppliers for resale. Some boat owners and fishers bypass the processors and sell fresh fish directly to the supermarkets, hotels, and restaurants.

Retail sales

Fish markets

The vendors that operate at the fish markets are small-scale and fix their own price and marketing arrangements. Barbados fish markets are administered by the Ministry of Maritime Affairs and the Blue Economy, under the Markets Division. They are responsible for the following:

- the establishment and management of all fish markets;
- collecting and accounting for all government revenue;
- inspection and licensing of vendors and cold stores;
- ensuring food safety through trained and qualified food inspectors in the areas of fish;
- the management of fishing harbours and dry dock; and
- advising the minister as it relates to the establishment of markets, prohibited areas and open vending activity (MMABE, 2021).

The eight fish markets are shown in **Figure 11**.

The Bridgetown Fish Market is very popular with locals. Located on the outskirts of the capital city, Bridgetown, this large market offers a wide selection of fish, and fish is typically sold on wooden or concrete stalls as shown in **Figure 12**.

One of the most popular markets is the Oistins Fish Market (Berinda Cox Fish Market). This medium-sized market offers a diversity of fish. It is located next to the popular Oistins Bay Garden where locals and tourists can dine on grilled and fried fish daily (Go Barbados, 2020a).

Other fish markets exist, but mahi mahi are not usually sold at these sites.

FIGURE 11: FISH MARKET LOCATIONS IN BARBADOS (SOURCE: GO BARBADOS, 2020A)

FIGURE 12: MAHI MAHI AT FISH MARKET

Supermarkets

Most of the large supermarket chains, such as Massy Stores and PriceSmart, a hypermarket, usually stock mahi mahi loins, fillets or bone-in steaks, year-round as tray or vacuum-sealed packs. The frozen fillets are sold as 4 fillet loins in a 1-pound package at an average price of BB$20/lb. The price ranged from BB$18.99/lb. to BB$21.00/lb. The frozen steaks are sold for up to BB$18.99/2-pound pack (and as low as BB$15.99/2-pound package).

Fish vendor-restaurants

Oistins is an active fishing town on the south coast of Barbados. Fish vendors in this town often have a dual role: they purchase fish from fishers and sell them fresh (processed or unprocessed as shown in Figure 13), and they also grill or fry the fish (**Figure 14**)and sell them at the popular Oistins Fish Fry, which occurs at the Oistins Bay Gardens. This is an outdoor, nighttime (usually from about 7:00 p.m.), daily, informal restaurant which also features drinks, craft and local music. The main night is Friday night. Consumers attend mainly for the fish (such as tuna, swordfish, marlin, mahi-mahi and flying fish), lobster and chicken, where the cooking process is visible. The fish is usually grilled. A plate of fish and a beer is priced at approximately BB$30–$35 (US$ 15–$17.50) (Go Barbados, 2020b).

FIGURE 13: FRESH FISH IN OISTINS
SOURCE: (GO BARBADOS 2020A)

FIGURE 14: GRILLED FISH AT THE OISTINS FISH FRY

Consumers

Households normally purchase ahi mahi directly from vendors and the remainder from the fishers, already gutted, with the head off. Households also consume mahi mahi from local restaurants, but most of mahi mahi sold at restaurants and hotels are sold to tourists.

4.1 *Prices and marketing arrangements*

Due to extremely low mahi mahi landings in 2020, from September to November 2020, more vendors than usual bought frozen mahi mahi from private importers (imported from Taiwan) and sold this as a replacement for the fresh mahi mahi that consumers prefer. Frozen mahi mahi is not a new phenomenon. However, only a few vendors have engaged in selling frozen mahi mahi in previous years. It is only done when the local mahi mahi landings cannot meet the market demand for the product, and they can provide the frozen product to maintain their livelihood. Local vendors do not perceive the frozen product as a competitor for the local fresh product because it is far less preferred. Nevertheless, if the Mahi mahi should remain in short supply over several years, it is possible for consumers to better accept this frozen product, especially if it can be sold at a lower price. There is, therefore, the possibility of competition emerging from the ready availability of this frozen imported product.

Usually, fishers sell the mahi mahi for BB$4/lb. The peak season for mahi mahi is March to April. At this time, the mahi mahi usually sells for BB$9/lb. The Christian celebration of Lent usually occurs during this time, so as a result, consumer demand for fish escalates as many abstain from meat products either partially or totally during the Lenten period. One key factor with mahi mahi harvest is the very high variability, even within a single week. As expected, mahi mahi market prices vary based on the volume of local landings. In December 2020, when landings were very poor, mahi mahi was sold retail by artisanal vendors for BB$7–$8/lb. When the fish is in abundance, this retail price will usually go down to BB$6/lb. Overall, the artisanal vendors provide a BB$1/lb. mark-up in their price, over the price they pay the fisher. The fishers normally price the fish according to the volume of sales, with vendors who purchase large volumes paying a lower price per pound.

Vendors usually operate independently, with persons finding and making their own marketing arrangements, including decisions on price, with their customers. Some of the vendors gut and head the fish for BB$5/fish as an intermediary process. The supermarkets sell the mahi mahi as high as BB$18.99/lb. for fillets, and the steaks (bone-in) are normally sold at a lower price (BB$17.25/lb.). Prepared mahi mahi sold by restaurants and hotels will be at an even higher price.

Mahi mahi has a 40 percent conversion of yield from the whole, head on, ungutted fish to the skin-on fillet. Based on a 20 percent discard of guts, and a yield of 50 percent for the transfer of whole, head on, gutted mahi mahi to a skin-on fillet (Chef Resources, 2021), the authors calculate that fishers receive approximately 53 percent of the supermarket retail price of the mahi mahi fillet.

4.2 *Impact of COVID-19 on vendors*

Several citizens, especially those who work in the Barbados tourism sector, lost their jobs or worked shorter hours as a result of lower tourist arrivals during the COVID-19 pandemic. Even though there is a strong demand for fish by Barbadians, there was a significant decline in sales from hotels and restaurants, which these vendors supplied. The COVID-19 pandemic resulted in a lower number of customers buying fish. In general, households maintained their fish purchase frequency at the artisanal vendors, however, these consumers usually bought less fish. This was largely due to lower income. In addition, Barbadians have a tradition of offering fish as gifts to friends and family members when they leave Barbados from holiday visits. With the significant reduction of tourists in 2020, this market for fish fell significantly and contributed to lower fish sales during the year.

Pre-COVID-19, artisanal vendors normally sold 8–11 pounds of mahi mahi, per customer. At this time, consumers are not buying on a regular basis. They are now buying mahi mahi and other fish based on how regularly they are paid, and the amount they are paid. This, therefore, adds to increased variability in mahi mahi and other fish sales. Pre-COVID-19, 5-pound packages of mahi mahi were a very popular product for sale by the artisanal vendors, but this is no longer popular, and consumers are now purchasing 2-pound packages of the mahi mahi. This allows them to get a greater variety of fish for set amount of money to spend on fish at any single purchase.

Pre-COVID-19, most of the artisanal vendors, who sell mahi mahi, were stationed at fish markets (primarily at Bridgetown and Oistins), which are located at the main landing sites. However, with the pandemic restrictions and the loss of earnings, vendors who had access to transportation shifted their businesses to either start or increase delivery of fish to consumers at their home. Most of the vendors are women, but mainly the male vendors had access to transportation. Therefore, mostly male vendors were able to take advantage of this new market arrangement to sustain their livelihood. Here, householders would call the vendors and order the various quantities of each kind of fish they wanted. They would agree on the price for each fish at the point of order, and the vendor would deliver the items to their respective homes at a convenient and agreed on time. Overall, though, only a few vendors shifted their market vending business to home delivery in full or in part. There are confirmed cases of at least a few vendors beginning online sales of their fish, using existing local online sales portals. Under this arrangement, the price per pound and type of fish cut is advertised, consumers can place their order using a Google form or other similar online form. Once the order is received, it is processed and the items delivered to the consumer's home. Persons engaged in this kind of business indicated that even after the COVID-19 pandemic, this kind of home delivery business is expected to be increased, whether the orders are done via telephone or online, as it is seen as a growth area for Mahi mahi sales and a more favourable working environment. The additional cost of transportation is normally included in the fish cost quoted to the consumers.

The artisanal vendors who provide home deliveries usually use two different pricing models. For the first kind, the sale price for mahi mahi changes on a daily basis, depending on the price they bought the mahi mahi for from the fishers. For the second model, the price per pound is fixed, even when there are variations in the purchase price. This second option provides the consumer with a better opportunity to budget and plan meals, and offers less risk for the seller with loyal clients. Under either model,

however, loyal clients may be offered additional price discounts from time to time, to help maintain the business relationship.

4.3 *Import competition and export*

Mahi mahi is imported whole, frozen and processed by industrial processors. One such company Atlantis SeaFood Inc sells fish steaks, bone-in or boneless and fillets for tuna, king fish, swordfish, blue marlin, butterfish, shrimp, bangamary, mahi mahi, whole red snapper, whitefish, smoked salmon, fresh salmon, cod and flying fish. Fillets are sold locally in bulk to retail and wholesale buyers under the Fish Fyne Brand of frozen seafood. This seafood is sold as vacuum sealed or tray sealed and is available at supermarkets and mini-marts throughout Barbados. In 2006, Atlantis Seafood Inc. was awarded the National Small Business Award 2006 as well as the Award for Excellence in Environmental Stewardship. They also received a certificate of recognition for excellence in customer service as well as a certificate of recognition in technology. In 2008, the company was awarded the Sectoral Group Award in manufacturing by the Small Business Association of Barbados.

The export market is not profitable if the price is US$3/lb. (BB$6/lb.) in Miami, USA for gutted and head off form. After costs for shipping and handling, gross profits may only be approximately BB$4/lb., which is not competitive relative to what can be obtained if the mahi mahi is sold directly to the local market. Countries with lower exchange rates, such as Peru and Ecuador, seem to be more competitive in the export market to the United States.

4.4 *Value chain overview*

Based on the value chain map**,** several value chains are identified, in order of relative importance:

1. Channel I: Fisher → Artisanal Processor → Consumer
2. Channel II: Fisher → Consumer
3. Channel III: Fisher → Retailer (Hotel/Restaurant/Supermarket) → Consumer
4. Channel IV: Fisher → Artisanal Processor → Retailer (Hotel/Restaurant/Supermarket) → Consumer
5. Channel V: Fisher → Medium/Industrial Processor → Retailer (Hotel/Restaurant/Supermarket) → Consumer
6. Channel VI: Fisher → Medium/Industrial Processor → Foreign Consumer

4.5 *Value chain actors*

The roles of 'main' and 'supporting' actors are presented in

Table 5: **5** and **Table 6**. Main actors are those that actually own the mahi mahi at some point along the value chain. So, for example, if someone provided storage facilities for the mahi mahi, that actor would be a service provider (or a Supporting Actor), because they do not actually own the mahi mahi.

TABLE 5: ROLES OF MAIN ACTORS

Stage	Main Actors	Role
Harvesting	Fishers – artisanal	Catch and land mahi mahi, maintain mahi mahi quality, and bring it to the market
Wholesale	Market-based wholesalers	Intermediaries between fishers and retailers

	Traders	Transfer product
Processing	Commercial processor	Processing mostly for the domestic market
	Community processor	Cleaning mahi mahi for the fisher/vendor
Retail	Supermarkets	Sell to households
	Market retailers	Sells to households at the Bridgetown Fish Market
	Speciality shops	Sell a range of local and imported seafood
	Restaurants/Hotels	Budget/moderate/upscale
Consumers	Households	End buyers in the value chain

TABLE 6: ROLES OF SUPPORTING ACTORS

Stage	Supporting Actors	Role
Input supply	Fishing materials, machinery and equipment importers	Supply equipment/parts for boat building, engines
	Cafeteria operators	Provide meals, snacks and drinks
Harvesting	Institutional support –	Data collectors, market managers
	Institutional support – Fisheries Division	Market manager. Sets regulations for gear, minimum sizes and fishing areas
	Fishing Cooperatives, non-governmental organisations, Training Institutions	Operating vessels, safety at sea, fish handling and fish processing
	Financial Institutions	Provide loans
Wholesale	Packaging suppliers	Provide packaging materials and services
Processing	Fishing Cooperative; Vendor Cooperative	Advocate for improved market access
	Regional Corporation	Local government bodies to manage markets
Transport	Van operators	Transfer of mahi mahi from fish landing site to vendor, retailer and/or consumer.

Fisheries Division

The Fisheries Division's mission is "to ensure the optimum utilisation of the fisheries resources in the waters of Barbados for the benefit of the people of Barbados through management and development." It is responsible for creating and enacting legislation to sustain the fishery, data collection, reporting and developing stakeholder participatory management. The Fisheries Division also acts as an intermediary between key primary and secondary value chain actors, providing technical and other training to fishers, vendors, other processors and traders, as needed. They are responsible for stock assessments and supporting research efforts in managing the catch and effort of the mahi mahi fishery.

Research Organisations

Several regional and international research organisations support the fishery, including:

- UWI-CERMES—undertakes implementation of the Small-Scale Fisheries Guidelines, alongside the Fisheries Division. It also provides graduate level training in policy making, fisheries and coastal management, consultancy and professional services to regional governments, leads regional sustainability projects, provides capacity building for civil society, private sector and governments, and public awareness and education.
- CANARI—provides capacity building (e.g. through training, small grants and mentoring) to strengthen fisherfolk organisations, supports policy development and advocacy, facilitates participatory natural resource management and promotes the Sustainable Development Goals in the region.
- FAO—involved at the public sector level in supporting policy development, management, data management, post-harvest development, etc., and capacity building for small-scale fishers and their organisations.

4.6 *Regulations*

The key regulations that support the capture and marketing of mahi mahi are listed below (Moore et al 2014 79):

- HACCP
- Barbados Fishery Management Plan
- Barbados Fisheries Act—provides for the management and development of fisheries in Barbados
- Markets and Slaughter-Houses Act—allows the Minister to regulate markets and slaughterhouses
- Territorial Waters Act—defines the territorial waters of Barbados
- Marine Boundaries and Jurisdiction Act—establishes the Exclusive Economic Zone for the island
- Coastal Zone Management Act—provides a comprehensive statutory basis for coastal management and planning
- Marine Areas (Preservation and Enhancement) Act—supports the preservation and protection of marine life in certain submarine areas of Barbados and for the establishment of underwater parks and art centres
- Marine Pollution Control Act—developed to prevent, reduce and control pollution of the marine environment of Barbados from whatever source

4.7 *Stakeholder perspectives*

Individual goals

The individual goals of those participating in the mahi mahi fishery is an important consideration in understanding the perspectives of the varied stakeholders. Key stakeholder goals are to have:

- more dependable income through more diversified fish species being processed;
- more employment along the value chain;
- more business growth via increasing customers through a more diverse product range;
- increased sustainability of the fishery by processing a wider range of species; this also reduces the pressure and reliance on a single species;
- reduced market risk through product diversification;
- new markets emerge for value added products; and

- a longer-term planning horizon for business sustainability.

Even though each stakeholder has their own goals, we have to ensure that the individual activities and goals are beneficial to the mahi mahi fishery as a whole. It is possible, for example, that increased harvesting may be beneficial to fishers and other stakeholders in the short term. But overharvesting can lead to the Tragedy of the Commons, so that the resource is depleted and fishers have to find new mahi mahi fishing grounds. Also, if all the readily accessible grounds are over harvested, the fisher cannot be sustained, and fishers will have to shift to a new fishery and lose potential revenue from the mahi mahi fishery. Since the mahi mahi congregates around the sargassum seaweed masses that are occurring more frequently in Barbados and other parts of the Caribbean, more juvenile mahi mahi are accessible to fishers, so more of them are being harvested. This problem of large numbers of juveniles being harvested is a relatively new one with the influx of sargassum in the region. Increasingly, consumers are requesting smaller mahi mahi, and this is driving the landings of the juvenile fish, while at the same time more juvenile fish are being accessed.

Group goals

Based on feedback from key stakeholders, the key group goals that should be commonly held by the fishery actors were ranked as

1. Sustainability of the fishery—one key way to attain this goal is to establish a minimum size, to reduce the catch of juvenile mahi mahi, which would have to be supported by appropriate legislation
2. Greater efficiency in the fishery—there should be enhanced use of by-products to reduce disposing of by-products and reduce spoilage
3. More public education—in particular, more information to the boat owners, fishers and vendors to educate them and final customers on negative effects on the fish stock from landing and selling juvenile mahi mahi. Stakeholders need to better understand the potential growth of the fish and the need to allow the fish to reproduce
4. Better communication between fishers and policy makers to ensure that fishers can better understand how the information shared is useful to them. It is also important that the policy advice shared needs to clearly identify how the advice can be used to benefit fishers

The identification of these group goals is very important because once key stakeholders have the same outlook in terms of what is most important to be achieved in the fishery, then individual actors can better tailor their short, medium and long-term activities to ensure that these activities are contributing to the group goals. Otherwise, it is possible to have individual, short-run gains, which can undermine the fishery value.

4.8 *Main limitations in meeting fishery goals*

Limited education and awareness are key constraints. There is also distrust between fishers and government's fishery managers, so enhancing this relationship will assist with the cooperation of fishers and help to change existing behaviours. There is a very high level of imports of mahi mahi. Local mahi mahi harvests are not enough to meet the local demand for this species, so as much as 50 percent of the consumption is imported. This is a potential source of significant competition, because if the imported price of mahi mahi falls over time, or if the export markets increase their trade advantage, then the local mahi mahi can be displaced, even though local consumers have a very high preference for fresh catch. There may not be adequate monitoring of imported mahi mahi, so there is the potential problem of having poor quality mahi mahi entering the market, as this will have a negative effect on consumer confidence.

Minimum size legislation is in draft, but has not yet been implemented. This may be a more important way to effect a change in negative behaviour by fishers and vendors. In addition, inadequate scientific knowledge is a key limitation because the local fishers are not sure what the status of the stock is and are seeing the catch of undersized mahi mahi. Even when there is a glut of local mahi mahi catch, there is still a high level of imports because vendors may be able to offer the imported mahi mahi at a lower price. The consumers appear to be driven by price considerations the most. Finally, there is no sub-regional management plan for mahi mahi, and this is a key limitation in ensuring that the fishery is sustainably managed over time.

5. National, regional, and international trade and trends

5.1 *Barbados's mahi mahi production*

Mahi mahi is the second largest species harvested in Barbados, by volume, after the flying fish. This was generally the case since 1970, except for 1992 and 2012, when the flying fish fishery's catch plunged and mahi mahi catch surpassed it. In general, up to 2009, the flying fish and mahi mahi catch generally moved in the same direction, with either no lag, or up to a one-year lag. This occurred, based on anecdotal evidence, because mahi mahi feed on flying fish, along with other fish. However, from 2010, there was no correlation in the catch of these two species, especially as flying fish catch continues to fluctuate widely on an annual basis.

Mahi mahi catch started at 500 tonnes in 1970 and rose to a high of 2,011 tonnes by 1988. Its catch generally fluctuated annually from 1982. However, since 1988, mahi mahi landings have shown a general downward trend, with dampened fluctuations since 1993. For the recorded years shown below, mahi mahi landings were the lowest ever recorded since 1970, at 185 tonnes and 191 tonnes in 2017 and 2018, respectively.

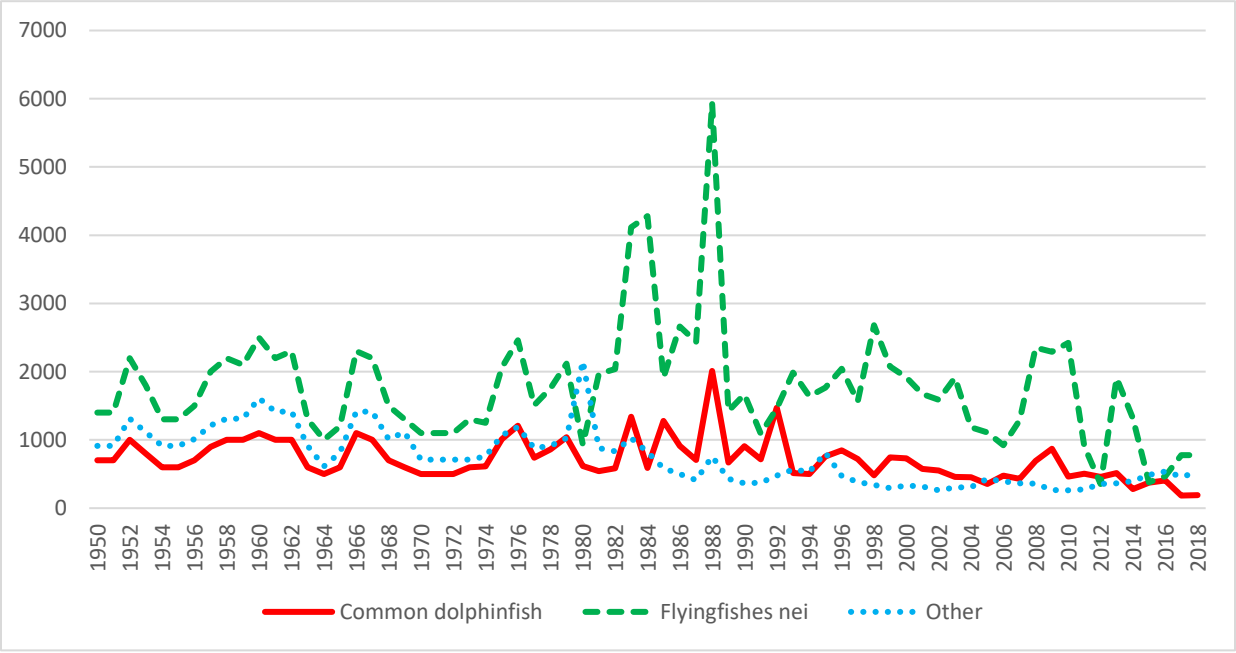


FIGURE 15: FISH HARVEST FOR BARBADOS, 1970-2018 (TONNES)

Source: FAO (2020)

These low catch levels in 2017 and 2018 are a cause for concern, given that when the catch started to decline in 2000, it did not begin to rebound until 2006, and even then, the catch increase seen by 2009 was short-lived.

Mahi mahi Export

Mahi mahi export volumes have declined significantly, from 2.0 tonnes in 2009 (**Table 7**), down to 5 percent of that volume, to 0.1 tonnes in 2016. This is likely due not only to the fall in landings but also to the increasingly competitive global environment, which is discussed in the subsequent section of this report.

TABLE 7: BARBADOS MAHI MAHI EXPORTS (TONNES), SELECT YEARS

Year	Exports	Value (US$mil)
2009	2.0~	
2014	0.07*	
2018	0.1	0.002

Source: CRFM (2020); * CRFM (2015);~ Table 30 CRFM (2012)

5.2 *Global market trends*

Worldwide, mahi mahi production increased significantly from 1950 (7,103 tonnes) to 102,316 tonnes in 2016 (**Figure 16**). In 2015, the highest catch was recorded at 125,062 tonnes (FAO, 2020). The top 15 producing countries together produced 114,000 tonnes, or 95 percent of total production in 2015. Peru, Ecuador, and Indonesia combined contributed almost 70 percent of the global mahi mahi production. In 2015, Peru, the top producing country, landed 62,000 tonnes (Sustainable Fish, 2018, p. 3). The importance of mahi mahi in the international markets has been growing rapidly, in particular in the United States—the top importing country.

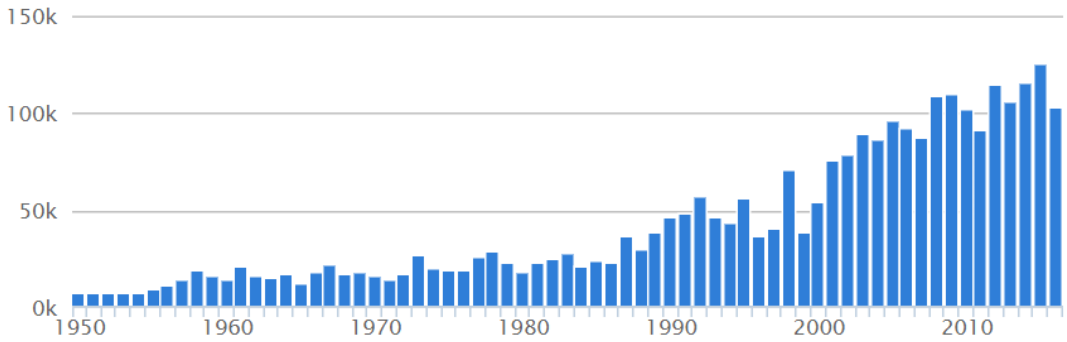


FIGURE 16: GLOBAL MAHI MAHI PRODUCTION, 1950 - 2016

Source: FAO (2020a)

In the United States, the mahi mahi fishing season runs from October to March, with catches peaking in January/February when it is most available in large quantities, causing prices to seasonally dip at that time. In August 2016, mahi mahi prices rose to a four-year high in the United States, led by lower production from Peru, Ecuador and Taiwan, which were the leading exporters to the United States at that time. This was due to an El Niño weather effect, which caused the mahi mahi to migrate out of the usual fishing grounds in Central and South America (Smith, 2016). Prior to this, mahi mahi prices skyrocketed to similar levels in 2014, when the price was so high that mahi mahi was taken off restaurant menus until the price fell again.

Mahi mahi is usually traded as a part of the HS Code[3] 030389, which represents fish, not elsewhere classified, whole, frozen, excluding fillets, livers, roes and other fish meat (Tridge, 2020). This broad classification makes it very difficult to separate mahi mahi trade values and volumes from trade of other species. As a result, this report focuses on trade to specific markets, such as the United States and the European Union, and exports from Central and South American countries, as these provide more disaggregated data.

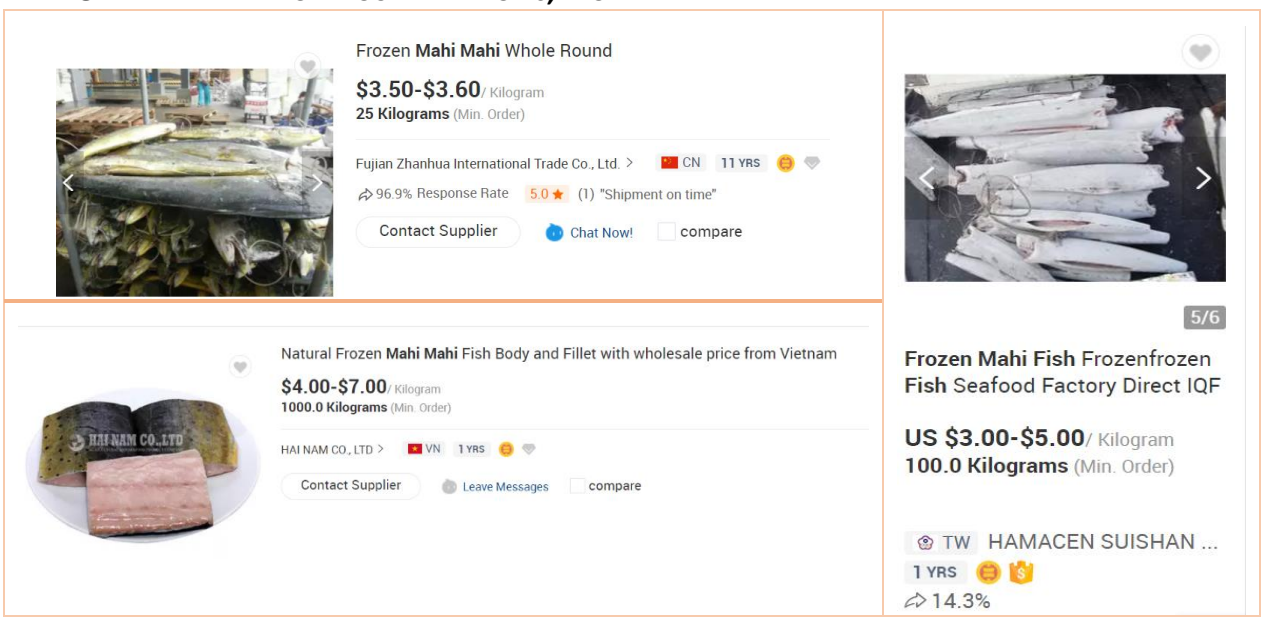
Global mahi mahi prices by form

Frozen mahi mahi has a very wide price range, depending on the volume of sales and product form (

Table 8: and **Table 9**:). Table 8 shows the following pricing by product form:

- Frozen whole, round: US$3.50–3.60/kg (25 kg minimum order) at Alibaba.com.
- Frozen, head-off, IQF: The price is quoted as US$3.00–$5.00/kg (minimum of 100 kg order)
- Frozen fillet**:** The price is quoted as US$3.85–$4.35/kg (minimum of 15 kg order)—China origin; US$4.00–$7.00/kg (minimum of 1,000 kg order)—Vietnam origin.

TABLE 8: MAHI MAHI WHOLE ROUND AND LOINS, FROZEN



Source: Alibaba (2020)

TABLE 9: KEY MAHI MAHI PRODUCT FORMS AND PROCESSING STYLES (SOURCE: TRIDGE, 2020)

[3] HS Code stands for Harmonised Systems Code and is a description and coding system developed by the World Customs Organization (WCO). It covers over 5,000 commodity groups, each identified by a six-digit code.

Form & Cut[4]		Processed Style	
Headed	PBO	Fresh	Frozen – Block Frozen
HO	HGT	Frozen – Raw frozen	Frozen - Superfrozen
Whole	Fillet	Frozen - IQF	Frozen – PHH (High Pressure Processed
HG	Portion	Non CO Treated	Dried
Gutted	Loin	CO Treated	

5.3 *The United States market*

Fresh and frozen mahi mahi are normally available from 8 to 25 pounds, year-round, but prices fluctuate significantly. Mahi-mahi has a mild sweet taste, making it popular in American restaurants. It is most abundant in January and February when the catches off Ecuador and Peru are at their peak (FishChoice, Inc). Import values usually exceed US$4 mil, but fell drastically from March 2020 (**Figure 17**).

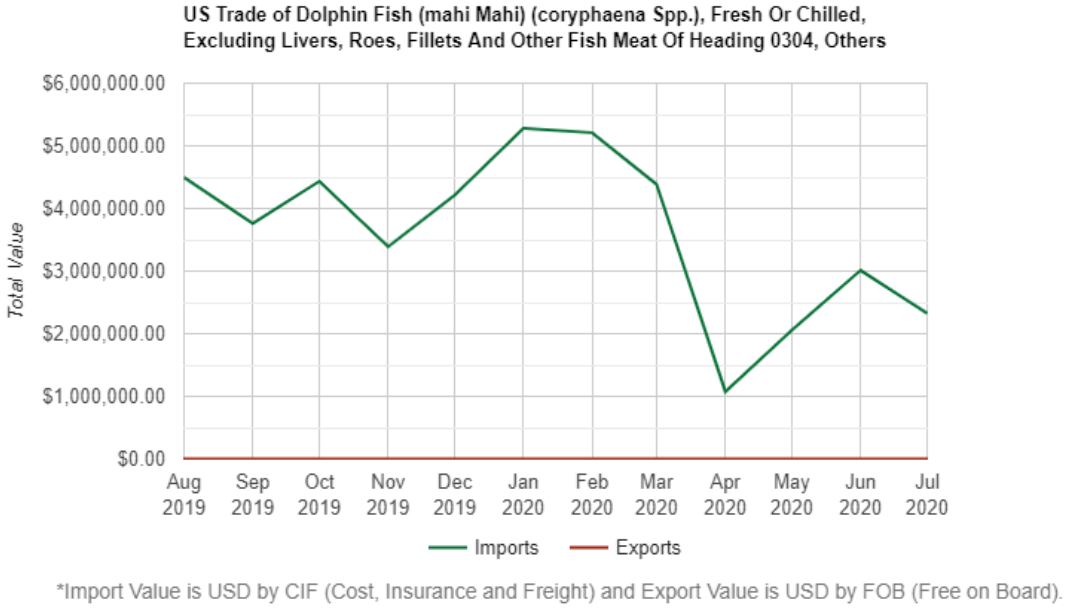


FIGURE 17: US VALUE OF IMPORTS AND EXPORTS FOR MAHI MAHI, FRESH OR CHILLED

Source: Descartes (2020)

Peru accounts for almost one third of mahi mahi imports to the United States. This is likely to be in the form of frozen fillets, classified under "Fish fillets, frozen, nei" or similar trade classification. Ecuador, which exports 88–92 percent of its mahi mahi to the United States, exported 56 percent as frozen mahi mahi and 44 percent as

[4] CO treated – Carbon monoxide treated | HG - headed and gutted| HGT- Headed, gutted, tail-off| HO – Head on | IQF- individually quick frozen | PBO -pin bone out

fresh mahi mahi. This was 31 percent of total fresh imports into the United States, with Ecuador leading the fresh market, followed by Panama and then Costa Rica.

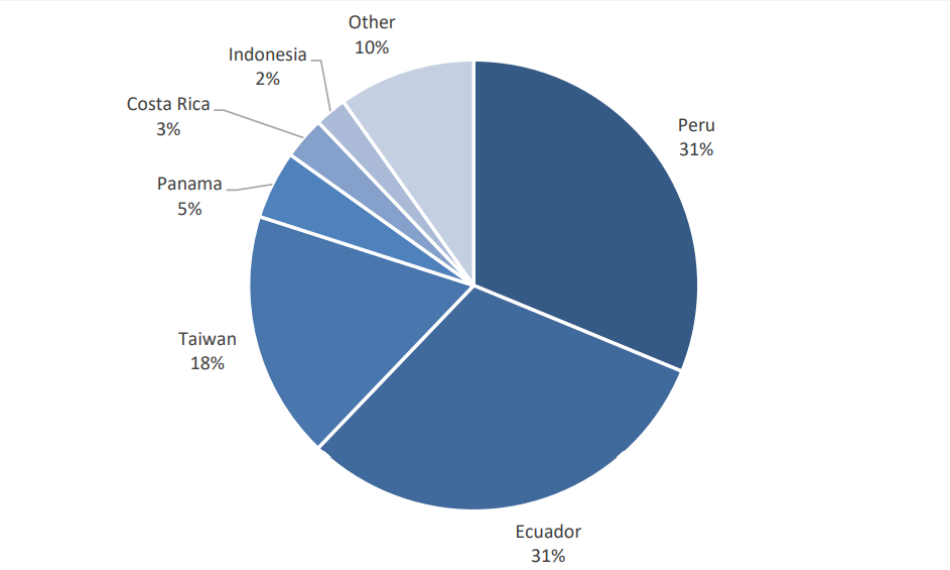


FIGURE 18: PERCENTAGE OF TOTAL MAHI MAHI IMPORTS (QUANTITY) BY THE US IN 2015 (26,100 TONNES), BY TOP EXPORTING COUNTRY.

Source: Sustainable Fish (2018)

In addition, in the United States, the value of mahi mahi imports have been rising faster than the increasing imports (**Figure 19**), making mahi mahi relatively more attractive as an export product. The price of mahi mahi in the United States increased rapidly from the late 1990s. In 1997, the price was approximately US$3.57/kg, but by 2017, the price roughly tripled to approximately US$10.87/kg (in nominal terms).

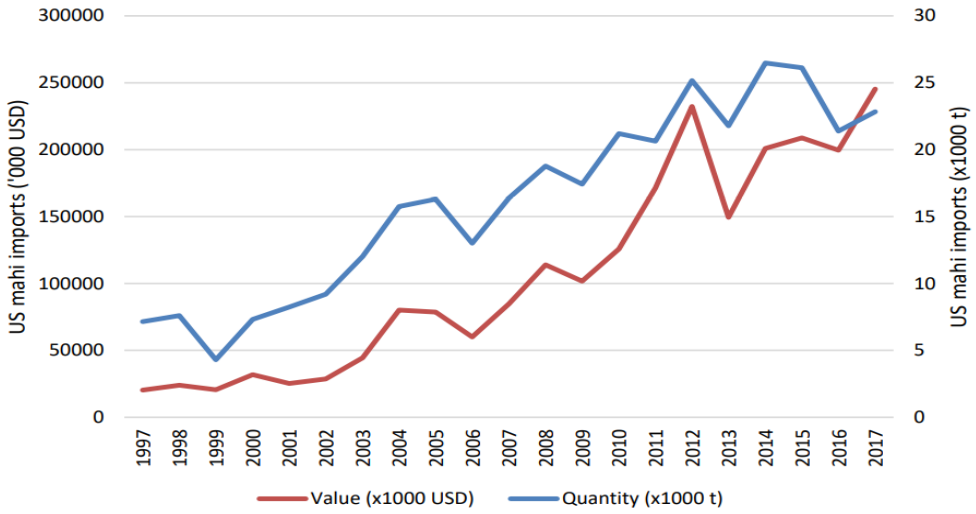


FIGURE 19: ANNUAL MAHI MAHI IMPORTS (BY QUANTITY AND VALUE) BY THE UNITED STATES, 1997 - 2017

Source: Sustainable Fisheries Partnership (2018, Fig 4)

Most of the imports, by value, to the United States were from Panama, followed by Ecuador and Costa Rica (Error! Reference source not found.).

TABLE 9: ORIGIN OF IMPORTS INTO THE UNITED STATES: JULY 2020

Top 5 Countries	Value
Panama	$1,085,617
Ecuador	$626,720
Costa rica	$266,481
Guatemala	$158,300
El salvador	$58,367

Source: Descartes (2020)

5.4 *Niche markets*

Tuna is the most consumed marine species in Europe, according to a 2018 study by the European Market Observatory for Fisheries and Aquaculture Products (EUMOFA). The same EUMOFA study shows that the 2.88 kg per capita consumption of the commodity group 'tuna and tuna-like species' in 2016 included 96 percent tuna and 4 percent swordfish. Tuna by-catch species, such as swordfish and mahi mahi, are niche products (CBI, 2020).

The key tuna by-catch species sold in Europe is swordfish, but mahi mahi also has a niche market, although it is harder to track because it has small trade volumes and shares a generic Harmonised Systems Code, which includes all frozen fish fillets. Mahi mahi is usually sold to Europe in frozen fillets, which are most popular in Western and Eastern Europe. While the tuna by-catch species are niche products, they have an established market with little competition and some species' market presence is growing (CBI, 2020).

Most mahi mahi are imported in frozen fillets from China, Vietnam and Indonesia. Chinese exports are usually 'double frozen' while Vietnamese and Indonesia supplies are produced 'single frozen', so they are considered to be of higher quality. Chinese products also have the reputation of often being treated with additives. There is some supply of fresh and chilled mahi mahi from South America, but these supplies are very unstable.

Double frozen fish is generally frozen whole, thawed for processing and then refrozen before being sold to the end consumer. Double frozen fish are perceived to be of low quality due to the multiple freezing processes that affect its freshness.

Mahi mahi is usually imported by Southern European and Eastern European markets for very niche markets, such as ethnic grocers, and it is usually of low quality. The European ethnic market is a good market for exporters to explore, considering the growing multicultural and diverse population of Europe. This is a useful trend to monitor in the long term, as European society becomes more exposed to multiculturalism and consumers pay more attention to new products and cuisines that come in this process. This trend could bring niche products into the mainstream (CBI, 2020).

If Barbados can provide a stable source of mahi mahi, this would be a very important factor in getting this product to a niche market. In addition, selecting a processing type that offers a high-quality end product will potentially allow a price premium to cover shipping and trade costs. The increased focus on illegal, unreported and unregulated (IUU) fishing and fisheries management can help exporters from Barbados become a preferred supplier to the European market if they can provide sustainable and consistent products.

Fish leather

Fish leather may also be another possible niche in the accessories and luxury goods markets. Mahi mahi fish skin can be used to make handcrafted fish skin leather accessories, such as the wallet from Peru shown in **Figure 20**. It is marketed as having a unique texture and long durability. It is also sustainable, eco-friendly, and a recycled byproduct of the fish industry and as a Fair-Trade item. This item was on sale for US$90.

FIGURE 20: GENUINE MAHI MAHI FISH LEATHER WALLET ONLINE SALE
Source: Spearman Artisanry 2020

5.5 *Sustainability measures*

Guatemala, Peru, Costa Rica

In 2013, Guatemala, Peru, and Costa Rica's longline fleet caught mahi mahi, which accounted for approximately 95 percent of imports to the United States at that time. They received an 'Avoid'[5] recommendation rating from Seafood Watch. This was largely due to concerns over moderate impacts on the stock and very poor impact on other species such as leatherback, loggerhead and hawksbill sea turtles. They also received poor scores on overall fishery management for both the retained and the non-retained species, even though their habitat and ecosystem scores suggested no negative impact or moderate impact. Ecuador, however, received a 'Good Alternative'[6] designation, even though there were similar moderate impacts on the stock. Ecuador's scores suggested that habitat and ecosystem had no impact on the harvest, and fishery management was good, compared to the poor rating in this area for Peru, Guatemala and Costa Rica (Montery Bay Aquarium, 2013).

In November 2018, government ministers, industry representatives and fishers' associations in Costa Rica, with the technical support of the United Nations Conference on Trade and Development (UNCTAD) and the United Nations Division on Oceans Affairs and the Law of the Sea (DOALOS), decided to target the tuna, mahi mahi and swordfish fisheries, as well as coastal fish (fresh and frozen products) for a National Oceans Economy and Trade Strategy. These fisheries were selected since they were collectively worth approximately US$52 mil in exports to the country annually. It was also noted that global demand for these fish species was growing by approximately 3 percent each year, which could provide good short- and medium-term opportunities for both artisanal and commercial fishers. The strategy was expected to focus on ensuring traceability and species sustainability, while improving competitiveness locally and internationally. This would support the artisanal longliner fleet, as well as other artisanal fishers (UNCTAD, 2018). Properly applied, traceability can improve inventory management, reduce operational inefficiencies and waste, improve yields, increase the pace of decision making, and fuel innovation across the entire business ecosystem.

[5] The "Avoid" category is for seafood which is overfished or fished or farmed in ways that harm other marine life or the environment.

[6] Seafood rated "good alternative" denotes that it cannot be considered fully sustainable at this time, and while still recommended for purchase, consumers should be aware that there are some concerns with how the seafood is caught or farmed.

In 2018, there were nine Fishery Improvement Projects (FIPs) that involved mahi mahi. Six were focused on mahi mahi longline fisheries (two in Peru, and one each in Panama, Ecuador, Guatemala and Taiwan). The other three FIPs are in the multispecies longline fisheries in Hawaii and Indonesia, where tunas are targeted, and mahi mahi is caught as by-catch (Sustainable Fish, 2018 p., 9). Eight of these FIPs were considered to be 'improving' in 2018, with a progress rating of 'C' or better. Furthermore, countries are increasingly engaging in discussions to increase efficiencies in supply chain management of mahi mahi (Sustainable Fish, 2018, p. 9; Sustainable Fisheries Partnership, 2021b).

Ecuador

The Ministry of Production, Foreign Trade, Investments and Fisheries (MPCEIP) in Ecuador, in collaboration with the United Nations Development Program (UNDP) and World Wildlife Fund (WWF) Ecuador, in March 2020 launched the Mahi mahi National Action Plan and traceability pilot programme (FIS, 2020). In Ecuador, mahi mahi is the most important artisanal fishery, with exports of fresh and frozen mahi mahi accounting for US$65 mil annually, supported by 4,666 fiber boats and 223 motherships. This traceability programme aims to identify all artisanal mahi mahi catch, using quick response (QR) codes, from the time of harvest. Information on gear used, location and time of harvest will be available and the harvest will be traced via the use of on-board cameras, the QR codes and followed to include processing by local women processor groups, for a very transparent process. This programme will also allow for stronger and stricter governance, as well as better spatial management and mitigate against the overexploitation of the resource (FIS, 2020).

Europe

Tuna by-catch species like patagonian toothfish, which experienced collapsing fisheries in the late 1990s due to overfishing and IUU fishing, were restored, after being taken off the menu in Europe after significant consumer concern. By 2017, approximately 70 percent of the global Patagonian toothfish fishery became Marine Stewardship Council (MSC) certified, ensuring sustainable management, which was a key factor in consumer acceptance. The Centre for the Promotion of Imports from Developing Countries (CBI) noted that the trend of sustainability is here to stay, as Europe actively pushes for traceability and responsible fishing as a way of improving stocks and preventing IUU fishing (CBI, 2020).

Mercury content varies widely among fish species, but is higher in general in larger predatory fish, such as swordfish and mahi mahi. Each species has a maximum level of metal content set by the European Union. Europe has strict compliance rules against mercury contamination in fish (CBI, 2020).

Implication for mahi mahi export

Increasing mahi mahi exports will depend on Barbados's ability to match or have a lower landed price for the product, or compete on another value offer (such as pro small-scale; pro-poor; fair trade). Regardless of the marketing approach taken, importers are using MSC certification as an entry-level requirement in the main import markets, as described above. As a result, Barbados can only compete well in mahi mahi exports to international markets in the long run, if it actively develops its fishery management to prove that it is sustainable, via a FIP, with the goal of being MSC certified to retain these markets. Furthermore, additional industry standards may be developed in the long run, but countries who are likely to be able to adopt any new standards will be those who already have sustainably managed fisheries. The longer Barbados takes to gain this certification, the harder it will be to penetrate these markets.

In the short to medium run, Barbados should consider increasing imports to the CARICOM region, as it will benefit from reduced tariffs as a member of the CARICOM Single Market and Economy (CSME). Furthermore, the high price for mahi mahi in regional markets (up to US$37.68/kg for fillets) makes this a much more attractive market, given that the shipment time and cost will be much less than going to the international

markets, and consumers will benefit from having seafood with a lower carbon footprint (less pollution is generated in moving the seafood from harvest to the final consumer).

Ecuador's experience can also be applied to Barbados. The use of QR codes to trace mahi mahi should be developed, in collaboration with the fishers, vendors and processors. Even while the FIP is being developed, such a system can increase consumer confidence in the product, and be used as a value-added service to consumers.

5.6 *Regional market trade*

Imports

The harvest and utilisation of fish and fish products is considered to be an integral part of the socio-economic fabric of the Caribbean region. **Table 11** shows that in 2017 and 2018, the total annual imports of chilled, fresh or frozen, fish for food for all CRFM Member States combined was approximately 28,459 MT in 2017 and 30,624 MT in 2018. The total value of these fish imports for all Member States combined was US$109 mil in 2017 and US$125 mil in 2018 (CRFM, 2020).

Table 10: **Error! Reference source not found.**

A review of the data in

Error! Reference source not found. shows that Jamaica, Haiti, Trinidad and Tobago and Barbados were the top importers of fish regionally for all categories of fish combined. Barbados accounted for 10.7 percent of regional imports of the volume of fish products in 2017 and 9.8 percent in 2018. The values of fish for food shown in

Error! Reference source not found. represent 99.9 percent of all the fish imported in 2017 (not shown) and 2018 for Barbados. The rest of fish imported was for bait and ornamental fish.

Exports

A review of the data provided in

Table 11 shows that for 2018, the three largest domestic exporters of fish, by volume, were Suriname, Guyana and the Bahamas. Together, they accounted for 84.9 percent of total domestic exports of fish for food from the region. However,

Table 11 shows that for the total fish exports for 2018, by value, Guyana had the highest value of US$110.9 mil. This was followed by the Bahamas with US$81.2 mil. **Barbados exported only US$0.5 mil in domestic food for fish, equivalent to only 0.2 percent of the region's exports.** Similarly, in 2017, Barbados exported only US$0.4 mil worth of domestic fish for food.

Table 11: **Error! Reference source not found.**

Regional sales

Mahi mahi is a lean fairly firm meat, with a sweet and mild-to-moderate flavor, very similar to swordfish. The dark portions you may find on a fillet can be trimmed away to produce a much milder flavor. Raw mahi mahi fillets will be pinkish to a grayish white; the cooked meat will be off-white with large, moist flakes. Mahi-Mahi is great for grilling and remains moist if it is not overcooked. You can grill mahi mahi with the skin on or off. It also adapts well to many seasonings and can even be blackened (Greenpeace, 2020). Mahi mahi is sold in fish markets, supermarkets and specialty fish shops (

Table 12).

TABLE 12: REGIONAL MAHI MAHI PRODUCTS AND PRICES

Product Description/ Source (Wild Caught)	Local Price/kg	USD Price/kg
 Source: Trinitrolley.com ORIGIN: Peru, Nicaragua, Suriname, Trinidad & Tobago, Taiwan, USA, DETAILS: Skin off, Boneless, Single Serving, Vacuum Packed Fillet, 8 oz/227 g, BB$11.31 (US$5.60) per pack (Ocean Delight); BB$17.26 (US$8.55) - Trinitrolley.com 2020 Brand: Ocean Delight	(BB$ 49.84/kg OceanDelight.com) (BB$ 76.06/kg Trinitrolley.com)	$24.69/kg $37.68/kg
 Source: PriceSmart 2020 Sea Spray Frozen Dolphin Steaks, Bag, 908 g/2 lb. @ BB$25.95 PriceSmart, Barbados; Ready-for-Pickup; All orders are processed overnight and available for pick up the day after the order is completed.	BB$28.58/kg	$14.15/kg
 Source: OceanDelight.com 2020 ORIGIN: Nicaragua, Peru, Suriname, Taiwan, Trinidad & Tobago, USA Steaks, skin-on, bone-in, Individually Quick Frozen, 24 oz/681 g, BB$ 14.88 (US$7.37) – 24oz pack, BB$ 53.56 (US$ 26.54) – 5 lb. pack Brand: Ocean Delight	(BB$ 21.86/kg – 1.5 lb. pack) (BB$ 23.62/kg – Trinitrolley.com)	$10.83/kg $11.70/kg

6. SWOT analysis and risk assessment of mahi mahi production

In Barbados, discussions on the development of the blue economy are ongoing. Based on previous stakeholder discussions highlighted by Moore et al (2014, 88), key stakeholders were asked to indicate the key areas needed for development of the fisheries sector. These areas are shown below, in order of importance (researcher assigned weight were used in determining these scores):

1. Conservation of marine resources/credit/post-harvest losses (Score = 81 each)
2. Communication and coordination (Score = 63)
3. Collaboration (Score = 56)
4. Capacity building (Score = 48)

The investment gaps were also assessed, and the key areas identified for development were (Moore et al, 2014, p. 88):

1. Institutional development/standards legislation (Score = 7 each)
2. Eco-labelling (Score = 6)
3. Target diaspora (Score = 5)
4. Quality and safety (Score = 4 each)
5. Market development (Score = 2)

In Barbados, fish offal could be utilised as fertiliser, in compost, or dried and made into pellets for feed. The opportunities in the fisheries sector suggested the following options (Moore et al, 2014, p. 89):

1. Process fish offal into value added products (Score = 64)
2. Clean technologies (technologies that relied on renewable energy) (Score = 49)
3. Mahi mahi fish leather (Score = 35)

Based on these stakeholder views and scores, the group goals of improved sustainability for mahi mahi coincides with the broader call for conservation of marine resources. This needs to be closely followed by the appropriate legislation to build fishery institutions and support conservation. It was also noted that greater emphasis should be placed on creating value added products from fish offal, versus the development of fish leather. Based on the total assessment of primary and secondary data and information from various industry stakeholders, a strengths, weaknesses, opportunities and threats (SWOT) analysis is shown for the mahi mahi industry in Barbados in **Table 14** and **Table 15**.

TABLE 13*:* SWOT ANALYSIS – STRENGTHS AND OPPORTUNITIES

STRENGTHS	OPPORTUNITIES
Production ▪ Adequate number of vessels and gear. ▪ Long tradition and experience in harvesting mahi mahi. ▪ Adequate monitoring of landings. ▪ Adequate provision of key inputs such as ice and cold storage. ▪ Growing fish and vendor associations to advocate for these stakeholders.	***Production*** ▪ Premium price for sustainably managed fishery. ▪ If the abundance of the stock is stable, and lower landings are due to lower trips, then increased trips should lead to increased landings. ▪ Long term production can be boosted with greater reduction in the capture of juvenile mahi mahi. ***Processing***

STRENGTHS	OPPORTUNITIES
▪ New access to life insurance by BARNUFO members. ***Processing*** ▪ Adequate processing capacity and technology to meet most local needs. ▪ Involvement of both artisanal and industrial processors. ▪ Provision of a wide range of product forms, on demand. ***Marketing/Trade*** ▪ Daily, year-round availability of mahi mahi in fish markets and other retail points of sale, such as supermarkets and hypermarkets. ▪ Increase in home delivery during the COVID-19 pandemic. ▪ Increase in mahi mahi sold locally online for home delivery. ***Consumption*** ▪ Strong local demand for mahi mahi and fish in general by householders. ▪ Vibrant hotel and restaurant sector boosts market demand for mahi mahi by tourists. ▪ Global mahi mahi demand is increasing rapidly.	▪ Increased marketing of waste bones and trimmings for fish stock, which can be used by restaurants, hotels and households. ▪ Additional research in the commercial use of mahi mahi bones and trimmings as fish meal for use in local animal feed plants. ▪ The growing CARICOM tourism sector is likely to have a demand for value added fish products, such as fish burgers, fish sausages, breaded fish and other convenience fish products. Mahi mahi, while high values, can be incorporated as the only fish ingredient or combined with other species. ▪ Provide training for all processors in the development of value-added products, such as fish sausages, burger patties and fish fingers for local and regional niche markets. ***Marketing/Trade*** ▪ Increased market penetration using online and telephone sales systems. Fishers, vendors or industrial processors can establish their businesses either individually, as a group, or in partnership with existing sales platforms for related products. This portal is more attractive as more consumers adopted the use of online websites for shipping during the pandemic. ▪ Investments in vehicles can expand the market size via direct-to-consumer approaches. ▪ Becoming MSC certified can secure new local, regional and export markets. ▪ The mahi mahi fishery can become green-rated, as designated by Sustainable Fisheries Partnership (SFP) Metrics. ▪ The mahi mahi fishery can eventually gain MSC full assessment. There are no fisheries globally, as of 2018 in MSC full assessment. ▪ Broaden management to include FIPs with global recognition. ▪ The Global Mahi Supply Chain Roundtable (SR) was formed in 2019, as an expansion of the previous Eastern Pacific Ocean Large Pelagics Fisheries SR. Barbados should seek to participate in this discussion

STRENGTHS	OPPORTUNITIES
	to be informed of new arrangements for management of the mahi mahi trade globally. ***Consumption*** ▪ Within the context of the increasing trends in nutrition-related chronic non-communicable diseases in Trinidad and Tobago, the consumption of mahi mahi offers the opportunity for a change in nutrition patterns that could contribute to healthier lifestyles.

TABLE 14: SWOT ANALYSIS – WEAKNESSES AND THREATS

WEAKNESSES	THREATS
Production ▪ In the Atlantic ocean, mahi mahi is assessed as a group along with other tuna and pelagic species, and their status is unknown (often due to a lack of information on the spatial structure of mahi mahi). ▪ Many undersized mahi mahi are harvested. ▪ There is no minimum-size requirement for mahi mahi, by law, though a draft proposal has been developed by the Fisheries Division. ▪ Slow implementation of applicable regulations to ensure sustainability for mahi mahi locally and in the Caribbean. ▪ Catch, effort and other market data is not readily available for analysis of mahi mahi production spatially and over time. Some of this information may not be collected and some may not be publicly available. ▪ Limited research on the factors that are contributing to mahi mahi's inter-year variability, the direct impact of sargassum on the stock and the long-term impact of climate change on the stock. ▪ Vendors have occasional difficulty in accessing ice within the market, promoting purchases from outside the market. This increases their sales price and lowers profitability. ***Processing***	***Production*** ▪ Consistent sargassum influxes or an increase in sargassum may lead to increase aggregation and capture of the juvenile mahi mahi, leading to overexploitation of the stock. **Marketing/ Trade** ▪ Lower-priced mahi mahi is imported from Taiwan and other countries. If these exporters become more competitive, they can potentially displace locally-caught mahi mahi. ▪ Countries are increasing the sustainability of their fisheries to become MSC certified. Without this certification, it will be increasingly harder for Barbados to compete in the export of mahi mahi internationally. ▪ Leading exporters such as Peru, Costa Rica and Indonesia are increasing their participation in FIPs, which will allow them to have more secure and potentially larger markets at the expense of potentially-new entrants such as Barbados. **Consumption** ▪ Competition from regularly imported mahi mahi, sometimes sold alongside the fresh product by artisanal vendors.

WEAKNESSES	THREATS
▪ Mahi mahi trimmings are not utilised commercially, except for minimal use of bones for fish stock by some hotels. **<u>Marketing/ Trade</u>** ▪ Very limited formal contract arrangements are in place. ▪ The slowness of vendors to shift to the online trading space may result in permanent loss of business for individuals whose customers have shifted to buying online. This also may concentrate profits towards those vendors who are able to successfully navigate this new market space. ▪ Long payment times by hotels and restaurants to artisanal vendors have reduced their ability to sell to these market actors over time, since they do not have the cash flow to support these types of transactions. **<u>Consumption</u>** ▪ Consumers are demanding smaller-sized mahi mahi.	

7. Conclusion

The mahi mahi fishery in Barbados is under significant threat from increasing numbers of juveniles being easily caught near floating sargassum mats. The increase in sargassum over time, due to climate change or other factors, is likely to further exacerbate this problem. Further, consumers, in response to more juvenile mahi mahi being offered for sale, have accepted these smaller sizes. Consumers have also been demanding the smaller-sized mahi mahi over recent years, and this behaviour intensified as a result of limited incomes due to the COVID-19 pandemic. Furthermore, female vendors were disproportionately affected due to the pandemic, since they generally did not own a vehicle, and, therefore, could not engage in mobile sales to households. The COVID-19 pandemic has accelerated the growth of online/telephone and mobile (WhatsApp) retail channels. Growth in these retail channels is expected to continue in the future.

Industry stakeholders agree that the fishery's sustainability is under severe threat, given the low landings of mahi mahi, and because the quantity of landings have not recovered in recent years, and remains very low. In addition, the mahi mahi's ability to recover in the short or medium term is not clear, given the general lack of research on this species globally, and the limited management of the stock in the Caribbean region.

Further, while the global mahi mahi market is expanding, consumers in these markets are increasingly demanding traceability of the product, as well as mahi mahi from sustainably-managed fisheries with needed certifications. Further, the Barbados mahi mahi fishery shows changes in the inter-year abundance, even with

the increased landings of juveniles. The development of a minimum-sized regulation for the species is commendable, but this needs to be put into law to encourage less landings of juveniles. The increasing use of iceboats in the fishery (and less Moses boats) reflects better targeting of mahi mahi and an improvement in landed fish quality, with the use of ice. One significant strength of the mahi mahi fishery is vibrant national fisherfolk organisation, BARNUFO, which works closely with the private sector, government and research and development agencies to provide training and policy support for fishers and vendors. In the first quarter of 2021, BARNUFO members are expected to access health and life insurance through a new product by insurers Sagicor. This provides much-needed livelihood support for fisherfolk and their families.

In addition to promoting new systems by which vendors and processors can market their products locally, Mahi mahi appears to have good market potential in the CARICOM region, as this high-value product is often utilised by the tourism sector, which was growing well pre-COVID-19, especially in countries such as Antigua and Barbuda. Additionally, new value-added products, such as fish burger patties, fish fingers and fish sausages have growing international appeal as consumers look for healthier food options. As the local and regional tourism sectors recover in the short to medium term, hoteliers and restaurant owners should be targeted for new business opportunities.

8. Recommendations

Overall, therefore, key recommendations are suggested below:

Sustainability

1. Limit harvest of juveniles through legislation. This will allow for monitoring and enforcement of the size regulations. Such legislation may include the implementation of annual or monthly landings limits for juveniles.
2. Conduct a stock assessment to determine the health of the stock.
3. Intensify public education to alert fishers, vendors, other processors and consumers of the potential threat of increasing the use of juveniles.
4. Increase public awareness on the long-term negative impacts of consuming undersized mahi mahi.

Marketing and value-added products

5. Provide vehicle and business support loans for delivery and direct-to-consumer sales. This can be spearheaded by the Fisheries Division, in collaboration with national financial institutions or by BARNUFO.
6. Provide innovative financing mechanisms to de-risk the sale of seafood by fishers to potential markets with slow payment terms (hotels etc.). This may be possible via a third-party financier that can provide a guarantee for payment or a bridging loan for the seller.
7. Conduct fisher assessment to determine reasons for reduced trips for mahi mahi and drivers for targeting behaviour.
8. Conduct market research on drivers of consumer behavior to determine consumers' price sensitivity for local versus imported mahi mahi.

9. Conduct market research on the market segments (size, purchase characteristics etc.) that should be targeted for increased online and direct-to-consumer mahi mahi and other fish sales. This would provide for a more efficient use of limited resources in developing this market locally.
10. Provide training for all processors in the development of value-added products such as fish sausages, burger patties and fish fingers for local and regional niche markets.

Export

11. In the short run, explore CARICOM markets for mahi mahi export, which are relatively easier to penetrate than international markets.
12. Set up a FIP for the mahi mahi fishery. Increasingly, this is seen as an entry-level requirement for countries that wish to export mahi mahi, including to the United States, the region's closest international market. This will further propel the conservation efforts and the public education campaign. Increasing local mahi mahi landings will also crowd out more mahi mahi imports, providing more earnings to local fishers while reducing the foreign exchange leakages.
13. Pursue MSC certification for the fishery, using a participatory approach.
14. Increase emphasis on utilising the trimmings from mahi mahi for by products, such as burgers and sausages. However, this may be for specialty markets as the lower price of imports has reduced this market opportunity.

It is clear that there are spaces for new and existing entrepreneurs in the Barbados mahi mahi market to seek additional value, but the resource management for mahi mahi has to be significantly strengthened to avoid poor long-term recovery.

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Appendix 1 - Methodological framework and identification of fishery value chains for focused Analysis

Methodology

This section outlines the process for the participatory selection and analysis of three fisheries value chains from the 7 StewardFish target countries. The key steps of this methodology are as follows:

1. Identification of value chains for consideration
2. Development of selection criteria
3. Desk research and interviews within country experts
4. Scoring and value chain selections
5. Development of preliminary value chains with a focus on primary actors
6. Participatory Webinar with key industry stakeholders in each country, where the key objectives are as follows:
    a. Outline the core concepts of a fishery value chain and how actors can benefit from using this approach
    b. Develop common goals for key actors
    c. Identify key primary market actors, their roles and risks
    d. Discuss and agree on key market limitations and solutions, in achieving common industry goals
7. Develop the description and identification of primary and secondary actors in each fishery, via online survey or online/telephone interviews

    Solicit estimates of volumes and prices of selected species from key industry stakeholders, via online/telephone interviews
8. Preparation of final value chain analysis report

Identification of Value chains for consideration

Each of the seven countries was asked to identify three species that require value chain development, based on their country objectives. Representatives (Focal points) from the departments of fisheries from the participating countries were contacted and asked to provide information on three value chains that they believed had high potential for value chain development under the project. Departments of fisheries were asked to provide any background documentation on the state of the fishery, state of the value chain, current catch levels and information on potential markets for the species/value chain products identified. Each of the seven countries was asked to identify three species that require value chain development, based on their country objectives. All countries provided three species/species groups, except for St. Lucia, who provided two species groups. It should be noted that while countries were asked to identify three species, value chains considered are not limited to specific species, but also can relate to specific products[7] within the value chain and catch methods[8].

Development of selection criteria

[7] For example, by-products of flying fish

[8] For example, Pelagic FAD fisheries

A literature review was conducted on methods for prioritisation of value chains for development[9], participatory methods for value chain analysis of smallholders/artisanal fisheries[10] and gender-based methods of value chain analysis[11]. Based on this global literature review, a number of potential selection criteria were identified by the primary researcher (Appendix 1). Potential selection criteria were discussed (with the technical Consultant leading the analysis, the technical CANARI team and the FAO Regional Coordinator for StewardFish) and a final set of criteria were agreed upon. The criteria for prioritisation of value chains for further development were as follows:

1. **Scale of positive impact on artisanal fisherfolk (numbers, employment and income).** How significant is potential impact of developing this value chain on artisanal fisherfolk who are the primary beneficiaries of this project?
2. **Potential for market development.** What is the potential of this species for market development based on end consumer demand and other factors?
3. **Environmental sustainability.** How well established is sustainability within this value chain/species? Considering the catch methods used, health of species stock, established sustainability practices, does the development of this value chain reduce or increase impacts on the ecosystem?
4. **Level of private sector involvement.** To what extent is the private sector, beyond artisanal fisherfolk, involved in this value chain? How interested is the private sector in investing/participating in this value chain?
5. **Socio-economic and institutional frameworks.** How strong are institutional frameworks to support the long-term development of this value chain? How equitable are existing socio-economic frameworks?

Desk research and interviews with local experts

A detailed desk review of available peer reviewed literature, grey literature and government reports was conducted to gather information on the state and potential of the identified value chains per country. Seven interviews were conducted with Department of Fisheries representatives. Interviews were multipurpose, as they were used to gather additional data on value chains identified and to validate earlier desk research findings. All interviews conducted were virtual and/or telephone based.

Scoring of value chains and shortlisting

The value chains identified were then scored using the criteria in Table 1. Each criterion could be scored on a rating scale from a minimum of 1 to a maximum of 5. The logic of the rating scale for each criterion is detailed in Table 1. Each criterion was assigned a weight based on its relative importance to value chain development, based on the literature review. Scores for each value chain under each criterion were assigned based on a combined analysis of the gathered data and the local expert interviews. Scores assigned by the technical consultant were discussed in detail with the CANARI and FAO representatives before finalisation to provide a final level of expert validation and ensure all available information on the value chains was considered. Scores for each value chain were then summed and a total score assigned. The Consultant, along with the CANARI and FAO representatives, decided that with limited resources to conduct three value chain analyses overall, the approach would be to undertake one per country for three of the seven countries, using a set of criteria to decide on the species for each analysis. The three value chains selected were thus those with the highest total score, with the caveat that

[9] http://pubs.iclarm.net/resource_centre/AAS-2015-02.pdf

[10] https://www.crs.org/sites/default/files/tools-research/participatory-market-chain-analysis-for-smallholder-producers.pdf

[11] https://www.oecd.org/derec/denmark/45670567.pdf

one value chain per country could be selected and the same species should not be selected for more than one country. Based on this system, the final selected value chains for development under this consultancy were as follows:

1. Queen Conch – St. Vincent and the Grenadines (score of 5 out of 5)
2. Spiny Lobster – Jamaica (score of 4.5 out of 5)
3. Dolphinfish – Barbados (score of 4.5 out of 5)

For full details on scoring please refer to Table 1 below.

Table 1: Value Chain Ranking (Value chains selected for further development highlighted)

	Criteria	Positive Impact on artisanal fishers (numbers, employment and income)	Potential for market development	Environmental sustainability	Level of private Sector involvement	Socio Economic and Institutional Framework	TOTAL
	Criteria Weight	0.25	0.25	0.15	0.1	0.25	1.0
Country		5=Very significant engagement 4= significant engagement 3=Fair engagement 2=Poor engagement 1=Very poor engagement	5=Very significant market potential 4= significant market potential 3=Fair market potential 2=Poor market potential 1=Very poor market potential	5=Highly established sustainability 4= Well established sustainability 3=Fairly established sustainability 2=Poorly established sustainability 1=Very poorly established sustainability	5=Very significant engagement 4= significant engagement 3=Fair engagement 2=Poor engagement 1=Very poor engagement	5=Excellent frameworks 4= Good frameworks 3=Fair frameworks 2=Poor frameworks 1=Very poor frameworks	
Antigua and Barbuda	Pelagic (Specifically FAD fishery) - mainly Dolphinfish, Yellowfin tuna and Blackfin tuna, Wahoo	4	2	4	4	4	3.5
	Diamond Back Squid	2	4	5	3	2	3.1
	Demersal Fish	5	4	4	3	4	4.2
Barbados	Flying fish, inclusive of byproducts	4	4	3	3	4	3.8
	Jacks (related to Sargassum)	5	3	3	3	4	3.8
	Dolphinfish (*Mahi mahi*)	5	5	4	4	4	4.5
Belize	Lobster Fishery	5	3	4	4	5	4.3
	Conch Fishery	5	3	4	4	5	4.3
	Finfish Fishery	4	3	4	4	3	3.5
Guyana	Artisanal Fishery (Bangamary)	5	4	4	4	3	4.0
	Artisanal Fishery (Siluriforms) - catfish	5	3	5	2	3	3.7
	Artisanal Fishery (Butter fish and Sea Trout)	5	3	4	2	3	3.6

Jamaica	Queen Conch	4	5	5	5	4	4.5
	Spiny Lobster	5	4	5	4	4	4.4
	Blackfin tuna	5	4	5	3	4	4.3
Saint Lucia	Lobster Fishery	3	3	4	4	3	3.3
	Pot Fish Fishery	5	4	4	3	4	4.2
St Vincent and the Grenadines	Queen Conch (*Strombus gigas*)	5	5	5	5	5	5.0
	Robin (*Decapterus macarellus*)	5	4	4	3	5	4.4
	Jacks (*Selar crumenophthalmus*)	5	4	4	3	5	4.4

Appendix 2 - List of webinar participants and interviewees

STEWARDFISH BARBADOS VCA WEBINAR AUGUST 27, 2020 - FINAL PARTICIPANT LIST			
No.	**NAME**	**ORGANISATION**	**JOB TITLE**
1	Dr. Beverly Wood	Analytical Services Laboratory	Director
2	Ms. Vernel Nicholls	Barbados National Union of Fisherfolk Organisations (BARNUFO)	President
3	Ms. Andrea Nicholls-Belgrave	BARNUFO	Public Relations Officer
4	Mr. Allan Franklin	-	Graduate Student (Resource Economics
5	Ms. Mercille Earle	Fisheries Division	-
6	Ms. Christine Pooler	BARNUFO	Secretary
7	Mr. Ian Moore	Cooperatives and Friendly Societies	-
8	Mr. Ashley Roberts	Atlantis Seafood	-
9	Mr. Adrian Wiltshire	ASK US Farms	-
10	Ms. Cathy-Ann Marshall	Ministry of Health	-
11	Mr. Gregory Franklin	Fisheries Division	Fisheries Officer
12	Ms. Joyce Leslie	Fisheries Division	Chief Fisheries Officer
13	Mr. Kyle Harris	Morgan Fish House	-
14	Ms. Sheena Griffith	BARNUFO	-
15	Mr. Henderson Innis	BARNUFO	Treasurer
16	Ms. Therese Moore	Fisheries Division	Fisheries Officer
Partners			
17	Dr. Patrick McConney	Centre for Resource Management and Environmental Studies of the University of the West Indies (UWI-CERMES)	Director
18	Ms. Sanya Compton	UWI- CERMES	PhD. Candidate
19	Dr. Shelly-Ann Cox	UWI-CERMES	Project Officer
20	Dr. Maren Headley	Caribbean Regional Fisheries Mechanism (CRFM) Secretariat	Programme Manager – Fisheries Management and Development
21	Ms. June Masters	CRFM Secretariat	Statistics & Information Analyst
22	Ms. Nadine Nembhard	Caribbean Network of Fisherfolk Organisations (CNFO)	Secretary
23	Mr. Terrence Phillips	Food and Agriculture Organization of the United Nations (FAO)	Regional Coordinator- StewardFish
24	Ms. Tracy Phillips	FAO	Administrative and Operational Assistant - StewardFish

25	Ms. Neema Ramlogan	Caribbean Natural Resources Institute (CANARI)	Technical Officer
Facilitators			
26	Dr. Sharon Hutchinson	UWI	Food and Resource Economist
27	Mr. Alexander Girvan	CANARI	Senior Technical Officer/Environmental Economist
28	Ms. Melanie Andrews	CANARI	Technical Officer

List of interviewees

Name	**Job Title**
Ms. Joyce Leslie	Chief Fisheries Officer, Fisheries Division
Ms. Vernel Nicholls	President, BARNUFO Central Fish Processor
Ms. Ashley Roberts	Atlantis Seafood
Mr. Mark Harris	Financial Comptroller, Morgan's Fish House
Ms. Sylvia White	Processor, Central Fish Processors Association
Mr. Gregory Franklin	Data Collector, Fisheries Division
Mr. Ian Moore	Cooperatives and Friendly Societies
Mr. Christopher Parker	Fisheries Officer, Fisheries Division
-	Massy Stores Supermarket, Suncrest, Holetown
-	Massy Stores Supermarket, Supercentre, Warrens
-	Massy Stores Supermarket, Oistins
-	Massy Stores Supermarket, Six Criss Roads
Overall Data	
Ms. June Masters	Statistics and Information Analyst, CRFM Secretariat, St. Vincent and the Grenadines

Appendix 3 : Seafood Landings in Barbados, 1970-2018 (tonnes)

Year	Carangids nei (Reef fish)	Common dolphinfish	Flying fishes nei	Marine fishes nei	Other	Total
[1970]	0	500	1100	100	613	2313
[1971]	0	500	1100	100	613	2313
[1972]	0	500	1100	100	613	2313
[1973]	0	600	1300	100	613	2613
[1974]	0	614	1250	106	650	2668
[1975]	0	1012	2063	176	893	4223
[1976]	0	1208	2462	210	978	4952
[1977]	0	741	1510	129	750	3188
[1978]	0	862	1756	150	762	3597
[1979]	0	1040	2119	180	847	4267
[1980]	0	619	933	1584	571	3747
[1981]	15	543	1968	369	498	3423
[1982]	39	585	2040	231	561	3492
[1983]	114	1341	4116	315	597	6534
[1984]	60	588	4281	171	594	5784
[1985]	93	1278	1914	147	343	3832
[1986]	54	912	2661	177	269	4112
[1987]	12	708	2436	78	319	3610
[1988]	6	2011	5936	93	657	8939
[1989]	31	670	1423	87	312	2585
[1990]	14	906	1670	54	296	3029
[1991]	23	715	1093	46	307	2292
[1992]	31	1470	1461	71	373	3585
[1993]	28	513	1987	69	467	3225
[1994]	15	499	1640	83	436	2829
[1995]	24	758	1766	220	569	3592
[1996]	28	849	2042	113	331	3523
[1997]	19	721	1566	74	291	2820
[1998]	14	482	2680	62	267	3655

[1999]	6	745	2075	72	216	3281
[2000]	28	728	1916	60	243	3185
[2001]	11	574	1673	109	198	2731
[2002]	10	553	1590	89	163	2530
[2003]	10	458	1912	90	201	2849
[2004]	10	455	1186	92	205	2159
[2005]	15	357	1112	113	304	2193
[2006]	20	476	922	107	264	1986
[2007]	16	428	1288	116	233	2235
[2008]	8	693	2354	109	242	3562
[2009]	9	870	2292	137	120	3507
[2010]	20	465	2424	98	144	3280
[2011]	10	505	908	127	137	1818
[2012]	39	459	354	145	169	1361
[2013]	9	514	1909	206	150	2976
[2014]	16	278	1314	219	162	2207
[2015]	43	373	378	215	228	1500
[2016]	43	405	469	277	217	1736
[2017]	44	185	777	208	211	1695
[2018]	122	191	775	230	166	1732

Source: FAO (2020b)