CONTRIBUTION 1.2

Food for Thought: Fisheries and Aquaculture Contributions to Food Security in the Caribbean

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Abstract

The past four years have seen a variety of external shocks that have had independent and cumulative impacts on food security throughout the world. For the Caribbean, extreme weather events, the Covid-19 pandemic, global energy crises, and ongoing international conflicts have all demonstrated the vulnerability of food systems in the region. Such exacerbated vulnerabilities have contributed to increased food prices, disruptions to food availability, accessibility, and diversity, and an overreliance on external trade. Cumulative trade deficits, in tandem with international instability and climate change, has visible negative socio-economic outcomes, particularly regarding local food system security, sovereignty, and sustainability.

Fisheries and aquaculture with a directed interest in local markets can play an important role in advancing food security and food sovereignty in the Caribbean. Progressive enhancement of the local supply and value chain through local production, processing, and consumption can promote tandem growth in adjacent sectors, facilitating cumulative capacity building for the future. NEXUS Coastal Resource Management, Ltd., through multiple projects in the region, offers a synthesis of various issues in the interest of expanding current discourse on local marine protein production, processing, accessibility, and consumption. Supported by our experience across the Caribbean, this paper examines some of the considerations necessary to promote greater use of the local fisheries and aquaculture sectors in promoting food security and food sovereignty in the Caribbean.

KEYWORDS: Food security and sovereignty, economic resilience, fisheries policy, market development, community health

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1. INTRODUCTION

Recent years have seen a variety of pressures that have had independent and cumulative impacts on food security worldwide. For the Caribbean, extreme weather events, the COVID-19 pandemic, global energy crises, and the effects of ongoing international conflicts on global food markets have all demonstrated various vulnerabilities within food systems in the region. Such exacerbated vulnerabilities have contributed to increased food prices, disruptions to food availability, accessibility, and diversity, and an over-reliance on increasingly costly external trade. Cumulative trade deficits, in tandem with international instability and climate change, has visible negative socio-economic outcomes, particularly regarding local food security, sovereignty, and sustainability. As such, enhancing local food systems in the Caribbean is a clear step toward softening these pressures on food security in the region.

Fisheries and aquaproduction sectors (aquaculture, mariculture, and aquaponics) with directed interest in local markets can play important roles in advancing food security and food sovereignty in the Caribbean. There is a need to displace protein imports with locally harvested fish and seafood products, which are often largely sold in export markets. Progressive enhancement of the local supply and value chain through local production, processing, and consumption can promote tandem growth in adjacent sectors, facilitating cumulative capacity building for the future. We have identified such overlap with health and safety measures in production and processing, local production of feed and bait, technological development for aquaculture and offshore fisheries, regulatory mechanisms for managing marine protein production, and promoting local education on nutrition, production, and economics.

NEXUS Coastal Resource Management, Ltd., through multiple projects in the region, offers here a synthesis of various issues and potential responses in the interest of expanding current discourse on local marine protein production, processing, accessibility, and consumption. Supported by our experience across the Caribbean, this paper examines some considerations necessary to promote greater use of the local fisheries and aquaproduction sectors in strengthening food security and food sovereignty in the Caribbean. This high-altitude survey of complex issues facing food security and food sovereignty, and the work being done to address them, offers a point of reflection for how we might begin to formulate longer-term, climate-resilient local fisheries and aquaproduction for sustainable blue economic development and national food security within the Caribbean.

1.1 Pressures on Caribbean Food Systems

By the nature of their geography, small island nations face shared challenges to food security. Limited land resources, insularity, exposure to extreme weather events, and dependence on external markets characterize many of these challenges (Connell et al. 2020). Environmental limitations on food systems are exacerbated by the general transition from agrarian societies to urban societies, which are increasingly dependent on tourism, light manufacturing, and other service industries, commonly experienced throughout the Caribbean. As a result, the island populations have become reliant on imported foodstuffs and use existing food resources largely to support tourism and export income.

Over the past twenty-five years, there have been several global trade disruptions due to international conflict, extreme weather events, changing trade relationships (Regional Trade Agreements), and global health crises. While hurricanes have profoundly impacted local harvesting capacities, global-scale supply chain disruptions such as the recent COVID-19

pandemic have had greater large-scale impacts on regional food supply and security since there were disruptions both in supply and distribution systems (Bene et al. 2021). Food insecurities have been further exacerbated by grain supply interruptions in the global market, largely due to the ongoing conflict in Ukraine having a global impact on the cost and availability of food resources (flour-based foodstuffs and livestock). Furthermore, "slow effects" of climate change on the ability of external markets to be food secure (gradual shortening growing seasons, insufficient seasonal rainfall, etc.) create competition for food resources from markets that are becoming less food secure. This results in increasing prices in the Caribbean marketplace.

The cumulative effects of these external pressures have illustrated the need to reconsider how local food resources are used to support economic resilience and food security. Recent research has indicated a need to reassess policies and strategies for Caribbean fisheries and aquaproduction to enhance their contribution to social and economic wellbeing of local communities and enhance their contribution to regional food security (Oxenford and McConney, 2021). While the common emphasis on GDP contribution tends to lessen the perceived severity of marine resource-related trade deficits, reassessment considering local climate resiliency, blue economic development, and enhanced utilization of local resources may help to address shocks to food systems caused by external factors. Simultaneously, greater consideration for the nutritional value of imported versus locally developed foodstuffs can shift efforts and investment to a greater valorization of local fisheries and aquaproduction through enhanced processing standards and more robust ecosystem management (March et al. 2023). Enhancing fisheries and aquaproduction activities to include processing for longer-term storage, product diversification, and local distribution increases the number and types of livelihoods supported by the industries. This in turn can enhance the local economic condition which improves food security, local wellbeing, and blue economic development.

1.2 Current State of Caribbean Fisheries and Aquaproduction

Currently, the fisheries and aquaculture sector in the Caribbean contributes to the development and stability of national and local economies through food security, employment, cultural continuity, recreation, and tourism. Fisheries and aquaculture production continue to be important sources of food for global communities, reaching a record of 214 million tons of aquatic animals and algae in 2020 (FAO 2022). Seafood is a significant source of protein in diets worldwide (Béné et al. 2015), and the health benefits of aquatic food consumption are widely documented (Golden et al. 2021, FAO 2022).

Climate change impacts have placed substantial stress on existing food systems, particularly in national economies that significantly rely on capture fisheries as a source of revenue generation and local food needs (Allison et al. 2009). To meet these needs, aquaproduction (aquaculture, mariculture, and aquaponics) is becoming an increasing focus to satisfy the current and future demands for high-quality aquatic foods to support local food security (Merino et al. 2012).

Historically, coastal communities in Latin America and the Caribbean have contributed more than 15% of world marine fish production; most of this production centers on small pelagic fish catch to be used as bait species or fishmeal for other large pelagics (Muñiz et al. 2022). Only 4% of all fish and fish farmers were in Latin America and the Caribbean in 2020 (FAO 2022). Furthermore, the Caribbean produced only 0.04% of the total world aquaculture production in 2018, which indicates significant room for growth (Wurmann et al. 2022).

Much of the existing focus on fisheries and aquaculture worldwide is on export and revenue generation, which undervalues the importance of domestic market development for food security and sustainable livelihoods (Wurmann et al. 2022). In the Caribbean context, new trade

agreements have facilitated increased seafood exports from Latin America to Asia, with the export share tripling from 9% to 26% over the past two decades (Muñiz et al. 2022). As foreign interest in developing a larger export market in the Caribbean continues to grow (Wurmann et al. 2022), a renewed focus on the contribution of fisheries and aquaproduction to environmental sustainability, food security, and livelihood generation could better support national development priorities.

1.3 Opportunities for Advancing Local Food Security

While there is no one-size-fits-all solution to these various complex issues related to food security, building climate-resilient and locally self-sufficient aquaproduction food systems offers a critical starting point for future sustainable Blue Economy development. Considering the various pressures on the Blue Economy and localized food security discussed above, a thoughtful introduction to these proceedings would be to consider how locally focused fishery and aquaculture sectors can contribute to a sustainable and holistic Blue Economy that is sensitive to local food needs and socio-economic growth. NEXUS's work in various marine production sectors in the region has illustrated that progressive enhancement of the local supply and value chain through local production, processing, and consumption can promote tandem growth in adjacent sectors, facilitating cumulative capacity building for the future. We have identified such overlap with health and safety measures in production and processing, local production of feed and bait, technological development for aquaculture and offshore fisheries, regulatory mechanisms for managing marine protein production, and promoting local education on nutrition, production, and economics.

This synthesis-based approach, informed by our experience working in the region, will consider the various interrelated ways that local food security and sustainable Blue Economy go hand-in-hand, examining some of the considerations necessary to promote greater use of the local fisheries and aquaproduction sectors in promoting food security and food sovereignty in the Caribbean. When directed toward the security of local food system, enhanced health and safety measures, technological and practical development in value-added processing, and investment into public education and awareness of market and nutrition options work in tandem to diversify local market protein sources and lessen reliance on food imports.

2. HEALTH AND SAFETY MEASURES IN LOCAL PROCESSING

One strategy toward better climate resiliency and local food security is to enhance domestic food processing capacity and associated health and safety measures to ensure sufficient seafood production and distribution to meet local needs. However, current practice sees most harvested products exported to international markets and then redistributed to the local market (IICA 2015). Additionally, as noted, local fisheries are experiencing uncertainties due to disruptions in global trade relations, climate change, and the lasting impact of the COVID-19 pandemic on international trade and travel. In the face of these challenges, every effort must be made to improve the quality of Caribbean seafood products for international markets as well as the variety of seafood products for domestic markets. Food security depends not only on a stable supply of food but also on a safe supply of food. Accordingly, high sanitary and phytosanitary (SPS) standards for Caribbean seafood products and processing should be established. Enhanced SPS measures are also important mechanisms to ensure food safety and security for local consumer markets, as well as safer export of processed food products to international markets.

The international market demand for high-quality seafood puts additional responsibility on Caribbean governments and industries to enhance national capacities to meet food safety and quality requirements. Therefore, there is a general need to improve compliance with international SPS standards and measures to enhance market access for Caribbean seafood production at the local, regional, and international levels. SPS legislation and regulations aim to protect states and their populations "against a range of specified risks to animal, plant and human health, including those arising from additives, contaminants, toxins or disease-causing organisms in food" (Scott 2007, p.1). With respect to Caribbean fisheries, SPS measures have two different roles: (1) protecting consumer and fish health within the territories of individual states (national) and (2) within the territories of their trading partners (international). These measures can protect industry and consumers' common interests and goals in Caribbean states, while simultaneously enhancing local harvest processing capacities. In tandem, pertaining to local, regional, and international markets, a harmonized approach to SPS regulation and management between Caribbean states could strengthen regional collaboration, establishing a unified framework for health and safety measures and standards in aquaproduction sectors.

As part of an Inter-America Institute for Cooperation on Agriculture (IICA) and CRFM commissioned report, NEXUS analyzed of opportunities and challenges for the fisheries sector in Caribbean states to determine necessary steps to harmonize SPS measures in the region. A matrix was used to cross-reference the relative strengths and weaknesses of Member States in relation to the completeness of their legislation, their commitment to the implementation of regulatory instruments, and the capacity across the fisheries value chain to meet their regulatory requirements (3Cs) (Table 1). The matrix analysis identified priority actions, which were incorporated into the roadmap to strengthen and harmonize fisheries SPS capacities in the region.

Table 1. Matrix analysis components used to cross-compare a state's ability to undertake SPS-related measures. Adapted from NEXUS, 2022

	Completeness	**Commitment**	**Capacity**
Definition	Represents the extent that national legislation addresses SPS measures and governance	Represents a state's demonstrated adherence to the implementation of the legislation and associated regulations	Represents a state's ability (technical, human resource, and financial) to implement good SPS practices
Select Indicators	Inclusion of SPS matters in national legislation and regulations The extent that SPS matters are addressed in legislation and regulations	Presence of working groups, organizations, and communication dedicated to SPS matters in aquaproduction Monitoring, control, and surveillance related to SPS activities routinely conducted	Sufficient personnel to implement SPS measures Access to training and requirements for staff across the value chain Availability of technical and financial resources

An underlining objective for all Member States in harmonizing SPS measures in the Caribbean is the establishment of dedicated and focused national legislation regarding SPS standards and protocols for fisheries and aquaproduction. The research and analysis revealed that SPS measures and protocols, when present, are often implemented through several different statutes and involve different governance institutions, such as those responsible for managing fisheries, food safety, health and environment, and trade. Consolidation of these measures and protocols, as well as defining clear authorities for their implementation, can facilitate improved coordination of fiscal resources and regulatory matters at national and regional levels. This increase in quality, clarity, and rigorousness of SPS regulations, if effectively implemented, will

raise national SPS standards and practices. This may increase local food safety status and facilitate international export of fisheries products.

The second objective of the harmonization roadmap was to increase commitment levels through the implementation of national legislation and regulations related to SPS measures. Information collected through project activities revealed the disconnect between what is legislated and what is happening 'on the ground' with respect to SPS in fisheries. As such, the development of resources related to education and training, particularly materials on food safety, is imperative to improve communication and awareness levels of SPS regulations across the value chain and incentivize compliance with such regulations. This focus can improve local food security through increased access to high-quality seafood products.

The third objective of the harmonization roadmap is to support the capacity for the fisheries sector to act on and meet SPS-related legislative requirements. Research and analysis showed that all Member States face significant capacity constraints that limit the ability of government agencies and fisheries value chain actors to actualize and enhance SPS measures across the region. As such, financial, technical, and personnel resources must be provided and allocated accordingly, to implement SPS-related legislation and associated regulations. These resources can enable increased compliance capacity, since value chain actors would have improved access to food safety and fish handling training, best practices programs (e.g., HACCP), and export certifications.

Our analysis of the completeness, commitment, and capacity of Caribbean states' policies and implementations of SPS measures revealed an unsatisfied opportunity to create a more accessible and safer domestic and international supply of seafood. Enhancing health and safety measures of seafood production at the national and regional levels supports the development of blue economies that are sensitive to local food needs and domestic processing industries. A robust health and safety infrastructure throughout the production network can also facilitate further practical development at various points in the production network. Within production environments rife for such development, and with a focus on enhancing local food systems, the quality of the consumer product increases allowing for further expansion of value-added processing within the sector.

3. VALUE-ADDED PROCESSING THROUGH TECHNICAL AND PRACTICAL INNOVATION

There is strong evidence that many nations are moving toward the advancement of aquaproduction (aquaculture, aquaponics, and mariculture). These activities serve as significant economic drivers to advance food production and food security (FAO 2020) and have been shown to produce more than the capture fishery (FAO 2022). This is consistent with global efforts to adopt a Blue Economy approach that strengthens resilience to climate change, food security, and livelihoods. However, efforts to advance aquaproduction are not evident to the same extent in all regions, and there is considerable room for growth in the Caribbean (March et al. 2023, Phang et al. 2023). Through an FAO-led initiative to harmonize aquaproduction policy, four Eastern Caribbean states sought to review existing policies, strategies, and regulations for aquaproduction, which were largely prepared prior to the global advancement of Blue Economy principles and concepts. In some cases, policies have lagged behind this growing awareness, as aquaproduction has tended to be embedded solely within pre-existing fisheries policies, legislation, and regulatory frameworks. Without developing aquaproduction-specific legislation that is sensitive to the distinctions between aquaproduction sectors and capture fisheries, current efforts can be insufficient or may undermine the realization of economic opportunities and food security that result from the diversification of marine resource production (Ruff et al. 2019). These factors were considered in the NEXUS review of current

national aquaproduction policies to prepare recommendations to enhance a regional harmonised aquaproduction policy.

As aquaproduction industries continue to grow throughout the Caribbean, consideration should be given to identifying the extent to which various stakeholders will be influenced or influence the multiple drivers of aquaproduction development in the region. Accordingly, NEXUS assessed stakeholder relationships in the context of key drivers of industry development, including the marketplace, which drives the demand for aquaproducts and establishes the financial opportunity for new and existing aquaproduction enterprises. Also evaluated were innovation and investment, which creates new opportunities and facilitates efficiencies and cost effectiveness in production, and policy which sets the governance objectives for the industry in the context of food security, food sovereignty, and contribution to the economy. The analysis revealed that sustainable development of aquaproduction will require the application of technology, market development, skills development, and access to capital to meet national environmental, social, and economic objectives for Blue Economy growth.

Innovation is one of the key drivers for the growth of aquaproduction industries, which includes development across the value chain. This innovation can be largely driven from within the industries (e.g., species diversification, nutrition and feed, processing technologies, extension services and training). For example, technology development is necessary to enhance the utilization of seafood for local food security, particularly in value-added processing so that there can be a greater diversity of seafood products (Adegoke and Tahergorabi, 2021). As a result, innovation can be seen as a significant driver for local aquaproduction contribution to food security that is influenced differently by the various stakeholders ***(Figure 1***). In this context, food security for consumers is seen to be influenced by other stakeholders who influence the availability of investment and innovation support.

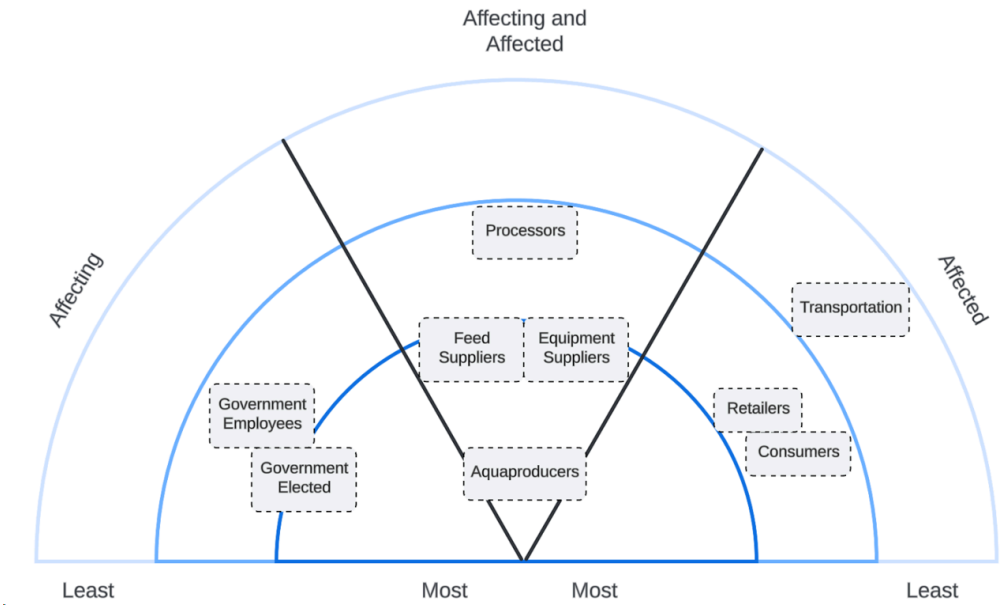

Figure 1. A high-level analysis illustrating the relationship between innovation & investment and stakeholder influence in the context of aquaproduction development (i.e., categorization of the degree that stakeholders affect or are affected by increased innovation & investment). Figure adapted from NEXUS, 2023.

In addition to the diversity in value-added processing, innovation can be in response to market pressures and national policy priorities to produce climate-resilient food systems, improve environmental sustainability, and reduce food waste (Sims et al. 2021). For example, new developments in remote sensing, wide-area information gathering (such as the use of drones), and web-based GIS tools facilitate the implementation of new mapping initiatives to determine areas of environmental suitability for aquaproduction activities. At present, there is limited information available regarding the application of such technologies at the national level throughout the Caribbean; the advancement of this technology could assist in the mapping of food production systems and identify opportunities for the enhanced contribution of fisheries and aquaproduction.

4. PUBLIC AWARENESS OF LOCAL MARKET BENEFITS

An informed and educated public can greatly contribute to conditions of food security. Awareness of the nutritional value of locally harvested foods, such as fish, shellfish, and marine plants, will enable families to make better informed decisions regarding use of local foods for cost-effective family nutrition across all socio-economic conditions. With greater harmonization of regional health and safety measures, and continued development of value-added processing and harvest utilization, there is a need to ensure that the benefits to local markets and food security are communicated and understandable for consumers. Informing the public about the availability of fish and other marine food products is particularly important when new products are being introduced into the marketplace from new aquaproduction operations and new value-added products are made from better utilized traditional capture fishery resources. When local consumers are informed of the health and cost benefits of consuming local seafood products, and they add these products to their regular diets, it helps to reduce the dependence of the local marketplace on imported foods, which in many instances have lower nutritional value.

Prioritizing the use of common food species for food security instead of using these species as bait species can further enhance the availability of local seafood products in the domestic marketplace. In some countries, small pelagic species are used as a traditional food while in others the same species are used primarily as bait in the large pelagic fishery. An example of this is the use of flyingfish as an important and traditional food in Barbados, while flyingfish are used as bait in the longline fishery in adjacent states. In addition to having economic value as

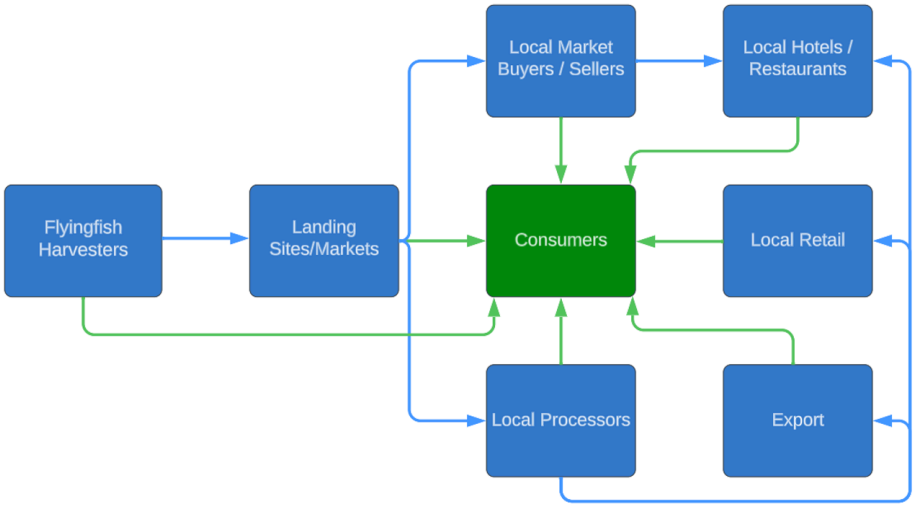

Figure 2. Simplified schematic of flyingfish value chain

food in Barbados, flyingfish has been an effective tourism marketing tool thus enhancing the economic importance of the species for the country. A recent value chain analysis of the flyingfish fishery demonstrated that flying fish is also of value as food in both domestic consumption and the tourist market (NEXUS, 2019) (see Figure 2).

Displacing the use of food species as bait through introduction of alternative or artificial bait can increase the availability of food resources, which can be marketed domestically or sub-regionally while not undermining the large pelagics commercial fishery which has been primarily focused on export markets. Public awareness and stakeholder education initiatives can enhance knowledge and innovation in the development of alternative bait strategies and promote harvest and value-added processing in the small pelagic food fishery. This could be demonstrated in the Eastern Caribbean where flyingfish is caught but not consumed, rather only used as bait. Public awareness campaigns could facilitate introduction of flyingfish products into the consumer market thus adding value to the fishers and contribute to domestic food security via a locally sourced and underutilized food resource.

Likewise, increasing availability of fish and aquatic products from the emerging aquaproduction industry may require public awareness campaigns that enhance consumer understanding of the nutritional and cost value of new species products available in the local marketplace. This is particularly important in ensuring the long-term viability of new aquaculture and aquaponics operations that may depend on local markets in their development cycle. In addition to providing local food, these industries increase the number and types of livelihood opportunities that further enhance the economic wellbeing of the community. Food security is dependent on economic wellbeing and, as such, diversifying livelihoods contributes directly to enhancing food security (Sibrian et al. 2021, FAO 2022).

An important step toward developing effective public awareness campaigns involves the use of up-to-date and accurate information regarding the fisheries and aquaproduction industries. Regarding the capture fishery, this requires advancing more robust and efficient data management systems that involve all players across the value chain, particularly harvesters. While IUU fishing and the impact of ghost gear on wild fish stocks is getting considerable attention, studies on flyingfish have demonstrated that greater attention should be given to improving the role of fishers and fishers' organizations in data acquisition, storage, and analysis to ensure a complete understanding of the state of the fishery. This will include using historical and current data to better understand climate impacts, species distribution, catch rates, and habitat integrity. More robust data collection systems that include fishers in the collection, storage, and analysis should impact their understanding of the importance of data and enhance their willingness to share data for the sustainable management of their industry. Furthermore, greater harvester participation may help to mitigate IUU fishing which can significantly enhance supply of fish to local consumers.

5. CONCLUSION

Taken together, these cases illustrate clear issues and potential measures necessary to address various regional food security pressures. Fisheries and aquaproduction are significant contributors to the local food supply. However, enhancing food security and advancing climate resiliency in the Caribbean fishery and aquaproduction industries will require strengthening value-added, sanitary processing capacity, promoting greater utilization of harvests in the local market, diversifying products available through aquaproduction, and better informing local consumers about the benefits derived from more robust nutritional options. These measures will also contribute to a stronger national and regional Blue Economy.

Food security depends not only on a stable supply of food but also on a safe supply of food. Currently, efforts are being made to enhance the quality and health safety of seafood products from the fishery and aquaculture industries. Safe and healthy products can better displace imported foods, particularly in the tourist market, and ensure that the supply contributes to the nutritional well-being and health of residents. Increased standards, regulations, monitoring, and enforcement of the safe handling and processing of products throughout the value chain is one step in advancing localized regional production capacity. Enhancing the local use and utilization of harvests will benefit the development of new products and diversification of species available in the marketplace. Robust data collection and management systems are necessary to ensure confidence in the safety of the food system and provides the information to inform the public about the benefits and nutritional options provided by local fisheries and aquaproduction.

Displacing imported foods through increasing the availability of locally produced and diverse fisheries and aquaproduction products in the local marketplace will take time to establish consumer preference for these products, including value-added products that meet consumer needs across all income levels. This will involve clear government policy on fisheries and food security encompassing government-sponsored public awareness campaigns, programs to support industry development, and support for skills training of new entrants into the industry. It will also involve industry-led advertising programs and investment in innovation. Collectively, government and industry-led initiatives will create new employment opportunities which will further enhance food security by establishing new sources of income within coastal communities.

Enabling policies that promote locally directed fisheries and aquaproduction-based food systems may contribute additional benefits to the circular economy. These include increased production and processing capacity, more diverse income opportunities within fisheries and aquaproduction, a more informed and eager local consumer, and less regional reliance on imported marine foodstuffs all contribute to economic resilience, food sovereignty, and food security.

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