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RAPID MARKET ASSESSMENT OF AQUACULTURE SECTOR IN MYANMAR

USAID BURMA RESPONSIBLE INVESTMENT & TRADE ACTIVITY

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Program Title:	USAID Burma Responsible Investment & Trade Activity
Sponsoring USAID Office:	USAID/Burma
Contract Number:	72048220C00001
Contractor:	DAI Global, LLC
Date of Publication:	January 29, 2021
Author:	Thura Swiss Co., Ltd.

This publication was produced by the Burma Responsible Investment and Trade Activity under Contract No. 72048220C00001 at the request of the United States Agency for International Development. This document is made possible by the support of the American people through the United States Agency for International Development. Its contents are the sole responsibility of the author or authors and do not necessarily reflect the views of USAID or the U.S. Government.

CONTENTS

TABLES AND FIGURES

Tables

Figures

ACRONYMS

ACIAR	Australian Centre for International Agricultural Research
BRAC	Bangladesh Rural Advancement Committee
CESD	Centre for Economic and Social Development
CSO	Central Statistics Office
DGL	Dawei Golden Land
DoF	Department of Fisheries
FAO	Food and Agriculture Organization
FDA	Food and Drug Administration Department
FY	Financial Year
GAqP	Good Aquaculture Practices
GEN	Gender Equality Network
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
HACCP	Hazard Analysis and Critical Control Points
HORECA	Hotels, Restaurants, and Cafes
ICT	Information and Communications Technology
IFPRI	International Food Policy Research Institute
ILO	International Labour Organization
JICA	Japan International Cooperation Agency
JIRCAS	Japan International Research Center for Agricultural Sciences
KOICA	Korea International Cooperation Agency
LIFT	Livelihoods and Food Security Fund
MCEA	Myanmar Crab Entrepreneurs Association
MFF	Myanmar Fisheries Federation
MFPPEA	Myanmar Fishery Products Processors and Exporters Association
MSA	Myanmar Shrimp Association
MT	Metric Tons
MYSAP	Myanmar Sustainable Aquaculture Program
NES	National Export Strategy
RFP	Rakhine Fisheries Partnership
RITA	Responsible Investment and Trade Activity
SME	Small and Medium-Sized Enterprise
TICA	Thailand International Cooperation Agency
UNCDF	United Nations Capital Development Fund
USAID	United States Agency for International Development

1. EXECUTIVE SUMMARY

1.1. Background and Objectives

The USAID Responsible Investment and Trade Activity (the Activity) is a five-year (2020–2025) USD 18.7 million activity that works with a broad range of international and domestic private sector firms and civil society actors to promote civilian ownership of the Myanmar economy. Through a facilitative and ecosystem-strengthening approach, the Activity helps increase responsible trade and private investment in Myanmar, and supports firms operating in or entering that country's market to improve corporate governance, business transparency, and competitiveness. As the government of Myanmar implements liberal policy reforms, a stronger and more diverse private sector is needed to achieve inclusive growth.

The Activity's approach to strengthening the private sector is guided by four objectives: 1) increase fair and responsible trade and investment in Myanmar; 2) improve corporate governance, business transparency, and competitiveness of local firms; 3) promote economic integration, investment, and trade for the benefit of people in non-urban areas; and 4) empower women to more fully participate in the economy.

The Activity achieves these objectives by identifying and supporting transactions that bring new investments into Myanmar, increasing gender-lens investing in the country, de-risking investments in firms located in non-urban areas, building the capacity of businesses to improve corporate governance, increasing private sector capacity to comply with new regulations, strengthening corporate accountability through civil society and media, and building the capacity of business-support organizations to promote trade and investment.

The Activity focuses on four core sectors: garments and textiles, agriculture, aquaculture, and off-grid energy. Information and communications technology (ICT) and transportation and logistics are supported as cross-cutting enablers of growth in the targeted core sectors. As part of the Activity's foundational assessments, its subcontractor Thura Swiss conducted rapid market assessments for each targeted sector. This report focuses on the aquaculture sector.

The objective of this assessment is to provide the Activity team and USAID a greater understanding of the dynamic trends and market growth opportunities in the sector, the key constraints to increased trade and investment, the ecosystem actors in the sector, and recommendations of priority areas where the Activity can intervene to help boost sector growth and achieve its programmatic objectives. This report presents a rapid assessment of opportunities and constraints tailored to the objectives of the Activity, rather than a comprehensive deep-dive assessment of the sector. The assessment will be used by the Activity team to inform its private sector engagement strategy and areas where the activity should channel its efforts.

1.2. Methodology

The rapid market assessment used both qualitative and quantitative data and relied on secondary and primary research. The Thura Swiss team first conducted a desk review of all relevant, previously conducted studies. The team then interviewed a sample of 15 to 20 actors in the sector, including private sector firms with representation all along the value chain (input suppliers, producers, and end

market buyers), sector-specific industry associations, enabling ecosystem actors, development partners, and industry experts.

In addition to sector actors, interviews were conducted with a range of cross-sectoral organizations, including private sector associations, equity investors, finance providers, development partners, and government agencies. The research team used a structured interview guide to inform qualitative information gathering.

This report covers an overview of the sector and key trends (Section 2); analysis of the end markets (Section 3); structure of the sector, value chain maps, and key ecosystem actors (Section 4); constraints to trade and investment, including ICT and transportation/logistics-related constraints (Section 5); inclusive development constraints with a focus on women and non-urban areas (Section 6); and recommendations (Section 7).

1.3. Key Findings

1.3.1. Opportunities

Fisheries in Myanmar, including aquaculture and capture fisheries, are an important pillar of the country's economy, contributing approximately 2 percent of the GDP, 6 percent of the country's total employment, and 5 percent of its export earnings in 2019. Given its significant importance for the economy, the Government of Myanmar has placed a strategic focus on fisheries development. In particular, it has prioritized the development of aquaculture due to its scale, inclusiveness, and significant growth potential. Aquaculture is considered a priority sector in the Myanmar Sustainable Development Plan (2018-2030), National Export Strategy (2020-2025), and the Agriculture Development Strategy and Investment Plan (2018-2023), all of which emphasize aquaculture development as a driver of economic growth, job creation, and inclusive and sustainable development.

Myanmar is one of the world's largest fisheries producers. According to FAO statistics for 2018,[1] the country ranked 13th in the world, at 3.16 million metric tons (MT) produced, which translates into 1.77 percent of global fisheries production. The country ranked 12th in capture fisheries production (2.03 million MT or 2.11 percent of global capture production) and ninth in aquaculture production (1.13 million MT or 1.38 percent of global aquaculture production). Fisheries as a whole is an important contributor to export revenues, with total fisheries exports in 2019-2020 reaching USD 847 million, an increase of USD 125 million compared to the previous year.[2] Myanmar exports fish, prawns, and crabs to a variety of markets, including China, Saudi Arabia, the United States, Japan, Singapore, Thailand, and the European Union.

Over the past several years, the aquaculture sector in Myanmar has been on a path of rapid and continuous development and has seen modest but steady increases in production and exports. Growth opportunities exist in both export and domestic markets. According to Allied Market Research, the global market for aquaculture was valued at USD 285 billion in 2019 and projected to grow to USD 378

1 Food and Agriculture Organization. "World Food and Agriculture - Statistical Yearbook 2020." FAO. https://doi.org/10.4060/cb1329en
2 https://www.mdn.gov.mm/en/fishery-exports-soar-over-847-mln-2019-2020fy

billion by 2027.[3] Access to high value export markets can be further enhanced through compliance with international market requirements at each stage of the value chain, diversification into high value products and effective market outreach programs. Priority sub-sectors with the highest growth potential include fish (which accounts for the largest share of the aquaculture sector), shrimp, and crabs.

- **Fish:** Global fish production (capture fisheries and aquaculture combined) is projected to increase from 176 MT in 2020 to 200 MT by 2029. Aquaculture will remain the main driver of growth in fish production globally and is projected to increase its share of total fish production from 47 percent in 2020 to 52 percent by 2029, overtaking the share of capture fisheries.[4] In Myanmar, fish culture accounts for almost 50 percent of total aquaculture farm areas. There is high potential for diversification from low-value fish, such as rohu, to high value fish, such as catfish, tilapia, and pangasius, which have growing demand both in export and domestic markets. Promotion of tilapia and striped catfish began over the last few years given their significant export potential, especially to the high value markets such as the United States. In addition, industry stakeholders believe that there is market demand and potential for developing processed higher-value products, such as fish fillets, snacks, and collagen.
- **Shrimp:** Although the shrimp sub-sector currently represents approximately 6 percent of total aquaculture production in Myanmar, industry stakeholders stress its importance for export growth. The shrimp industry is on a path to revival after a collapse in 2009 – 2010 due to an outbreak of white spot disease and the widespread destruction of shrimp farms. According to industry experts, export opportunities for shrimp are growing, given the rising global demand and Myanmar's close proximity to key consumer markets such as China. Other major global markets are India, Indonesia, Malaysia, Vietnam, the EU, Canada, Mexico, and the United States. So far, Myanmar has been exporting to only a handful of countries, including China, Thailand, and the EU markets, so there are many untapped export markets.[5]
- **Crabs:** Crabs – both mud-crabs and value-added soft-shell crabs – are among the top 10 fisheries exports, and export market demand has been growing. Mud-crab exports go to China, Thailand, Singapore and Korea, whereas soft-shell crab is exported to Australia, the United States, EU, Japan, China, Hong Kong, and Korea. According to FAO statistics, between 2003 and 2015, the worldwide production of soft-shell crab more than doubled, from 151,900 to 344,100 tons, 80 percent of which was produced by China (the vast majority), Vietnam, Myanmar, Singapore, Indonesia, and Philippines.[6] Myanmar has the largest producer and distributor of soft-shell crabs in the world: Aung Moe Khine Co., Ltd which has a monthly production of over 40 tons. Soft-shell crab production, in particular, has been receiving a lot of interest from aquaculture producers as it fetches a higher price, almost double than that of mud-crabs.

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3 Kumar, Sumesh, and Roshan Deshmukh. "Aquaculture Market by Environment and Fish Type: Global Opportunity Analysis and Industry Forecast, 2021-2027." Allied Market Research. November 2020. https://www.alliedmarketresearch.com/aquaculture-market

4 OECD-FAO. "Agricultural Outlook 2020 – 2029." OECD-FAO https://www.oecd-ilibrary.org/agriculture-and-food/oecd-fao-agricultural-outlook-2020-2029_1112c23b-en

5 Ibid

6 Barbalho Hungria, Diogo. "Global Status of Production and Commercialization of Soft-shell Crabs." Springer International Publishing. July 2017. https://gia.org.br/portal/wp-content/uploads/2017/11/10.1007_s10499-017-0183-5.pdf

1.3.2. Constraints

To take advantage of these export and domestic market growth opportunities, the aquaculture sector will need to address several constraints. Priority bottlenecks include poor compliance with market requirements, lack of product diversification, poor quality control and food safety protocols, limited availability of financing instruments, lack of access to production technologies, deficient know-how and skills, gaps in business enabling environment, and limited capacity of the government to support sector growth. Investments are required in hatcheries, new technologies, and food safety compliant and certified processing and cold storage facilities.

1.3.3. Recommendations

This report recommends a range of interventions that the Activity or other interested development partners could support to help the sector address its key constraints to increased trade and investment. The following recommendations have been tailored to the Activity objectives and anticipated scope of work, with a focus on recommendations that can yield tangible results within the Activity's five-year time frame:

- **Facilitate foreign investments in promising businesses** by inviting potential foreign corporate and financial investors to visit growth-stage aquaculture companies in order to explore investment opportunities, as well as facilitate access for local businesses to investment readiness services to help prepare them to meet prospective investors.
- **Facilitate access to finance** via alternative financing schemes that would focus on the aquaculture sector, as well as facilitating access to investment readiness services from local accountants to help prepare the companies to access debt financing.
- **Increase compliance with market requirements** by raising private sector awareness of key voluntary standards, helping aquaculture companies build their capacity to comply with these standards and other market requirements, and linking them with potential buyers.
- **Support linkages with buyers** by supporting Myanmar aquaculture companies' participation in trade fairs through cost-sharing schemes and arranging business-to-business meetings, as well as facilitating the necessary advisory and technical assistance to enhance capabilities, product development, and quality upgrading in order to meet buyer requirements.
- **Support establishment of de-risking mechanisms** such as a first loss facility to encourage the establishment of an aquaculture-focused investment fund via the provision of technical advisory support in collaboration with private sector associations, banks and other access to finance eco-system actors. Other de-risking mechanisms could include subsidized credit, guarantees, insurance, value chain financing and other hybrid capital financing instruments, trade financing, internal value chain financing, and long-term loans at favorable interest rates for all types of businesses along the aquaculture value chain.
- **Support private-sector advocacy** of sectoral associations such as Myanmar Fisheries Association (MFF), Myanmar Shrimp Association (MSA), Myanmar Crab Entrepreneurs Association (MCEA), and Myanmar Fishery Products Processors and Exporters Association (MFPPEA) through advisory and technical assistance so these associations are well equipped to work with the Government and advocate for the necessary improvements in regulatory framework for sector growth.

- **Improve access to technologies** by partnering with financiers such as microfinance institutions and banks to facilitate development of a dedicated fund for mechanizing micro and small-scale farms through loans, facilitating rent-to-own models or leasing programs in partnership with interested machinery and equipment suppliers, and providing linkages to international technology experts.
- **Increase economic opportunities in non-urban areas** by facilitating the establishment of contract farming schemes and relationships with processors, exporters, and off-takers, as well as providing the necessary technical advisory support.
- **Support innovation and product development** by facilitating access to finance for farms to invest in new technologies, equipment, and tools through partnerships with financial institutions such as banks and microfinance institutions in order to support development of more suitable financial products and loan schemes, as well as required technical assistance and advisory support.
- **Improve small- and medium-sized enterprise (SME) management and production practices** by enhancing the use of technology, such as mobile applications. For example, collaborate with existing mobile application providers to expand their reach and support commercial sustainability, and collaborate with sectorial associations and various ecosystem players to facilitate the adoption of improved farm management technologies.
- **Assist in establishing traceability systems** by working with downstream players that are producing at scale and are targeting high value export markets such as processors and exporters, and supporting them in implementing traceability systems with their suppliers. The Activity could support these processors/exporters by facilitating access to the already available traceability software or supporting the development of new software via grants.

2. OVERVIEW OF THE SECTOR AND KEY TRENDS

2.1. Overview of the Aquaculture Sector

Fisheries in Myanmar, including both aquaculture[7] and capture fisheries,[8] is an important pillar of the country's economy, contributing approximately 2 percent of the GDP in 2019 according to World Bank estimates.[9] According to the National Export Strategy (NES) for 2020-2025, fisheries contribute 6 percent of the country's total employment and 5 percent of its export earnings. Given its significant importance for the economy, the Government of Myanmar has placed a strategic focus on fisheries development and has included it in several master plans, which also include upgrading of infrastructure, improving farming conditions and quality of the end produce, expanding market access, enhancing private sector investment, enabling a sound regulatory framework, improving working conditions, and ensuring inclusive growth.[10]

While capture fisheries have dominated fisheries for decades, concerns over exploitation of fish stocks, environmental sustainability, and labor rights have led to a shifting focus on the development of aquaculture production, which is now regarded as a major sector when considering its scale, inclusiveness, and significant growth potential. For these reasons, the government has prioritized the development of aquaculture and included it in several of its medium- to long-term development plans. Aquaculture is considered a priority sector in the Myanmar Sustainable Development Plan (2018-2030), National Export Strategy (2020-2025), and the Agriculture Development Strategy and Investment Plan (2018-2023), all of which emphasize aquaculture development as a driver of economic growth, job creation, and inclusive and sustainable development.

Myanmar is one of the world's largest producers of fisheries. According to FAO statistics for 2018,[11] the country ranked 13th in the world, at 3.16 million metric tons (MT) produced, which translates into 1.77 percent of global fisheries production. The country ranked 12th in capture fisheries production (2.03 million MT or 2.11 percent of global capture production) and ninth in aquaculture production (1.13 million MT or 1.38 percent of global aquaculture production). Official statistics from the Department of Fisheries (DoF), shown in Figure 1, however, differ from FAO estimates, and indicate total fisheries production for the same period at 5.8 million MT, with 1.1 million MT or 18.8 percent coming from aquaculture production and 4.7 million MT or 81.2 percent from capture fisheries production.[12]

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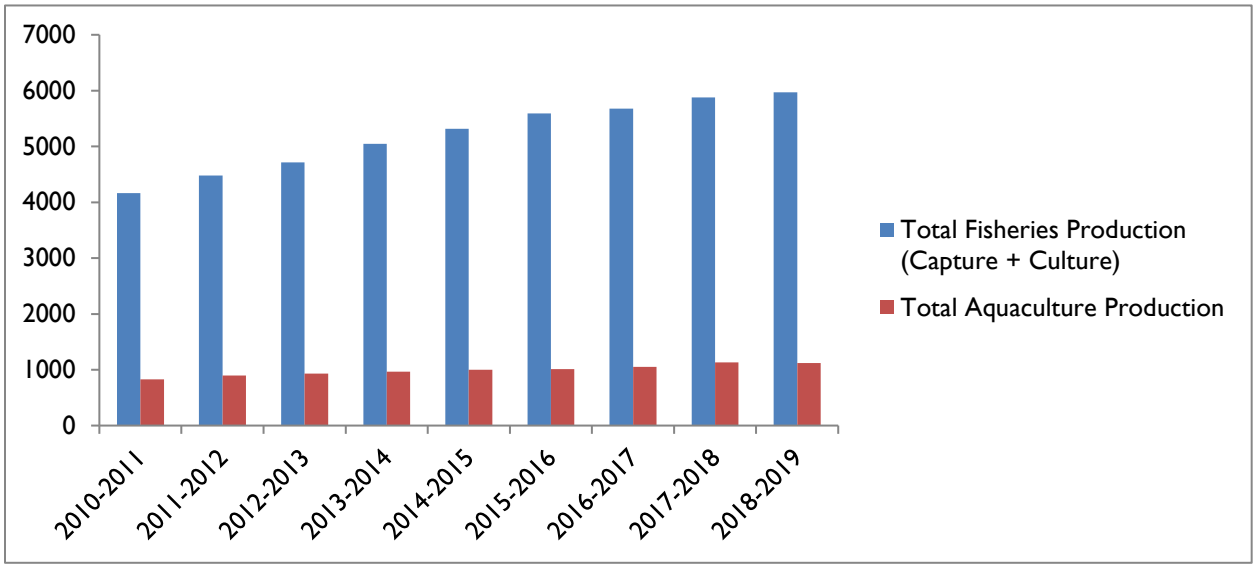
7 According to FAO definition, "aquaculture is the farming of aquatic organisms, including fish, mollusks, crustaceans, and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated. For statistical purposes, aquatic organisms that are harvested by an individual or corporate body which has owned them throughout their rearing period contribute to aquaculture, while aquatic organisms which are exploitable by the public as a common property resources, with or without appropriate licenses, are the harvest of fisheries."
8 According to Green Facts, "capture fishery refers to all kinds of harvesting of naturally occurring living resources in both marine and freshwater environments."
9 https://www.forestdepartment.gov.mm/sites/default/files/Documents/Fishery%20Policy%20Brief%20English.pdf
10 National Export Strategy, Fisheries Sector Strategy, NES 2020-2025
11 Food and Agriculture Organization. "World Food and Agriculture - Statistical Yearbook 2020." FAO. https://doi.org/10.4060/cb1329en
12 For the same period, the DOF's statistics are as follows: 1.11 million MT for aquaculture production, 0.34 million MT for leasable fisheries, 1.25 million MT for open fisheries, and 3.15 million MT for marine fisheries, bringing the total fisheries production to 5.8 million MT.

FIGURE 1: TOTAL FISHERIES AND AQUACULTURE PRODUCTION IN MYANMAR (THOUSAND METRIC TONS)



Source: Department of Fisheries

Fisheries as a whole is an important contributor to export revenues, with total fisheries exports in 2019-2020 reaching USD 847 million, an increase of USD 125 million compared to the previous year (USD 722 million in 2018-2019), according to statistics from the Ministry of Commerce.[13] Exports of fisheries have been growing steadily since 2015 but have slightly declined since the start of the COVID-19 pandemic. However, Myanmar Fisheries Federation (MFF) expects to see a large volume of exports in the post-pandemic period.

Myanmar exports fish, prawns, and crabs to a variety of markets, including China, Saudi Arabia, the United States, Japan, Singapore, Thailand, and the European Union (EU). Industry experts estimate that for fish, shrimp, and crabs, about 40 to 50 percent of total production goes to export markets. According to Myanmar Fisheries Statistics from the Department of Fisheries, in 2018-2019, fish made up 66 percent of exports volume and 50 percent of exports value, whereas shrimp contributed 2 and 8 percent, respectively; crabs and other crustaceans accounted for 32 and 41 percent, respectively. However, data on the respective shares of aquaculture and capture fisheries in the total fisheries exports are not available, and therefore export growth trends for aquaculture products specifically are difficult to estimate.

Over the past several years, the aquaculture sector in Myanmar has been on the path of rapid and continuous development. The sector has seen modest but steady increases in production since 2010, expanded access to high value markets, enhanced adoption of international standards in farming and processing activities, engaged with the international community for promoting the sector, and expanded local value chains by substituting imports with local products.[14] Despite having achieved this progress, aquaculture is still relatively less developed compared to other sectors like crop agriculture. Constraints and gaps are significant throughout all of aquaculture sub-sectors and include distance from global

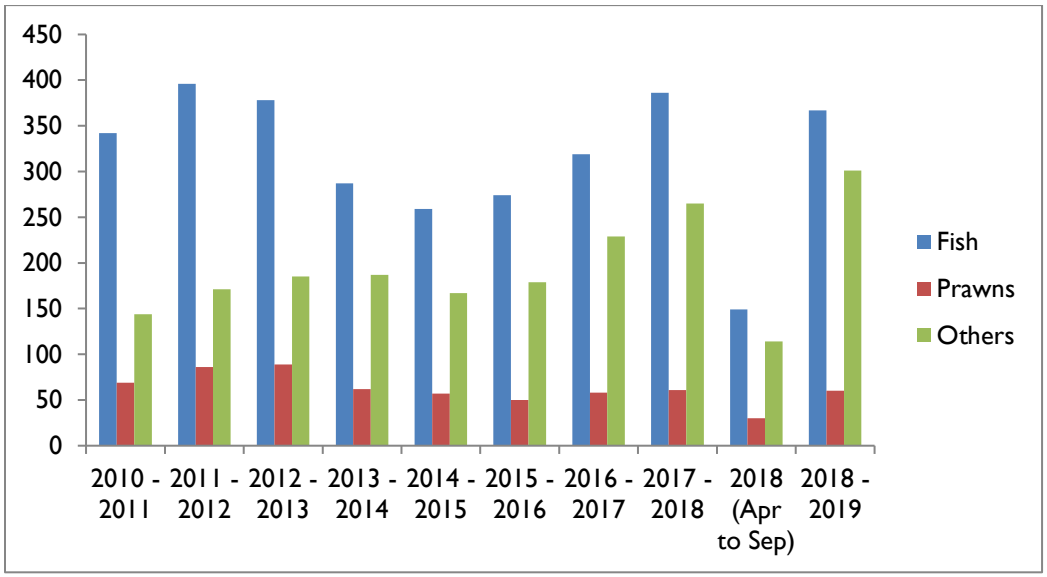
13 https://www.mdn.gov.mm/en/fishery-exports-soar-over-847-mln-2019-2020fy
14 Thiha Ko Ko. "Myanmar Launches Aquaculture Roadmap." *Myanmar Times*. March 17, 2020. https://www.mmtimes.com/news/myanmar-launches-aquaculture-roadmap.html

markets, lack of investment in infrastructure, insufficient access to finance, and shortage of technical skills and know-how. Realizing the need for concrete strategies and plans to further promote the sector growth, the government developed a National Aquaculture Development Plan (2019-2023) with input from key sector stakeholders to support sector development.

2.1.1. Key Aquaculture Sub-Sectors

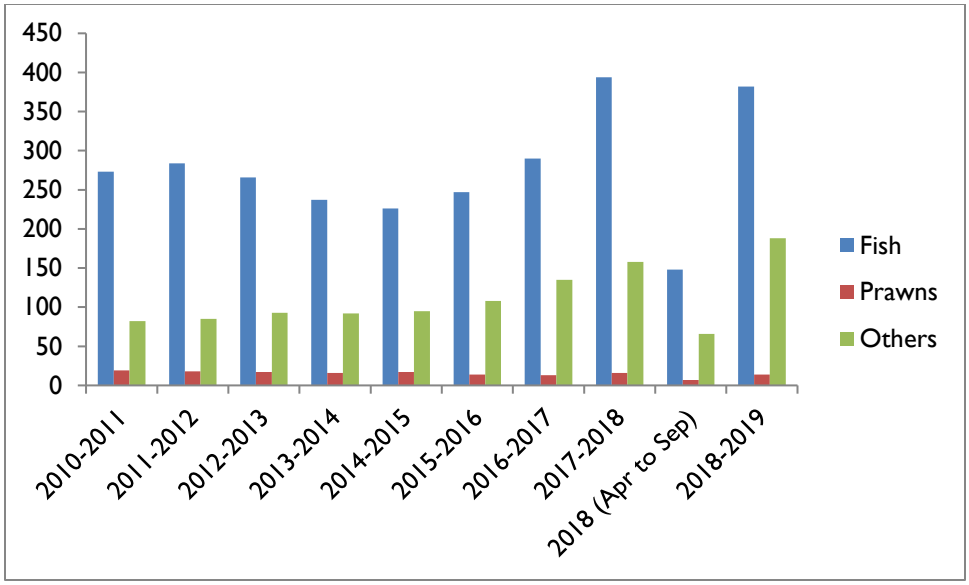
Analysis of the aquaculture sector and its key sub-sectors is complicated by the limited availability of data on the cultured fisheries production, since the majority of data sources treat the fisheries sector as a whole and combine the data for cultured and captured fisheries. That said, in interviews, industry stakeholders indicated that fish accounts for the largest share of the aquaculture sector, followed by shrimp and crabs. Other sub-sectors, such as seaweed and other types of crustaceans, are still relatively small and underdeveloped and receive limited attention from the public and private sectors due to their perceived lower growth potential compared to the priority sub-sectors of fish, shrimp, and crab. According to data from the Department of Fisheries (DoF), in 2018-2019, Myanmar exported USD 728 million worth of fisheries (captured and cultured), of which fish accounted for USD 367 million, prawns (all types of captured and cultured shrimp and prawns) accounted for USD 60 million, and others (which include crabs and other crustaceans) accounted for USD 301 million.

FIGURE 2: TOTAL FISHERIES EXPORTS (2010-2019) (USD MILLION)



Source: Department of Fisheries

FIGURE 3: TOTAL FISHERIES EXPORTS (2010-2019) (THOUSAND METRIC TONS)



Source: Department of Fisheries

FISH

Global fish production (capture fisheries and aquaculture combined) is projected to increase from 176 MT in 2020 to 200 MT by 2029. Aquaculture will remain the main driver of growth in fish production globally, and is projected to increase its share in total fish production from 47 percent in 2020 to 52 percent by 2029, overtaking the share of capture fisheries.[15]

In Myanmar, fish culture accounts for almost 50 percent of total aquaculture farm areas, or 247,000 acres. The main fish products are rohu, catla, common carp, grass carp, mrigal carp, and silver carp species. Promotion of tilapia and striped catfish began over the last few years given their significant export potential, especially to the high value markets such as the United States. Key export markets for Myanmar are China, Saudi Arabia, Japan, Europe, and the United States.

Out of all aquaculture sub-sectors, fish culture in Myanmar receives the most assistance from international development partners, donor agencies, non-governmental organizations (NGOs) and international non-governmental organizations (INGOs), such as GIZ and WorldFish, and as result this sub-sector has seen significant progress over time.

- New hatcheries have been developed, although there is still significant room for upgrading existing facilities as well as establishing new facilities to fulfill the demand.
- Industry experts indicate that aquaculture exports have been growing with enhanced market access. However, as diversification and product development initiatives ramp up, there is a strong need for market expansion for new species and products, such as tilapia and striped catfish (Pangasius).

15 OECD-FAO. "Agricultural Outlook 2020 – 2029." OECD-FAO. https://www.oecd-ilibrary.org/agriculture-and-food/oecd-fao-agricultural-outlook-2020-2029_1112c23b-en

- The processing sector has also improved with the emergence of facilities that meet international standards. In addition to new players entering the sub-sector, upgrading and extension of existing facilities is taking place in an attempt to reach higher value markets such as the EU and the United States. These processing facilities have undergone upgrades to meet the requirements of key end markets, for example, Halal certification, EU market certifications, and U.S. Food and Drug Administration certification. EU certifications for processing facilities automatically grant access to other markets such as Japan and Korea, and are therefore important for the industry.
- The sub-sector has become more integrated, with both local and international investments taking place, especially in feed manufacturing. Multinational feed manufacturers such as Aller Aqua, CJ, DeHeus, and Green Hope have established presence in the country.
- Capacity of the DoF, the focal point for the fisheries industry, has been improving over the years with the support of the Ministry of Agriculture, Livestock, and Irrigation, as well as donors and development partners.
- The fisheries ecosystem has also been strengthened with emergence and increased participation and collaboration of more ecosystem players, as well as the roll out of effective schemes and programs by development partners and donors, as well as private-sector led initiatives, such as the Integrated Aquaculture Complex by the MFF in Pantanaw of Ayeyarwaddy Region.

Despite these developments, the sub-sector still has a lot of areas for improvement, such as building a self-sufficient broodstock production system that will enable all species to be produced locally at scale, increasing compliance to international standards and market requirements, diversification into high potential species, promoting value addition, enhancing market access and expansion, promoting responsible, inclusive, and sustainable development, bridging financing gaps, and promoting private sector investment.

SHRIMP

According to the National Aquaculture Development Plan, the shrimp sub-sector represents approximately 6 percent of total aquaculture production. All stakeholders interviewed for this study have stressed the importance of prawns to export growth. The shrimp industry is on a path to revival after a collapse in 2009-2010 due to an outbreak of white spot disease and the widespread destruction of shrimp farms, especially white shrimps (*Vannamei*), by Cyclone Nargis. Although the sub-sector is being rejuvenated, it has not yet fully recovered, and its resilience is still questionable due to limited capacity to prevent, control, and mitigate another such outbreak.

Myanmar has a diverse shrimp industry.

- Black tiger shrimp (*Penaeus monodon*) is cultured extensively in Rakhine and some parts of the Ayeyarwaddy Delta Region.
- Freshwater prawn (*Macrobachium rosenbegii*) production in semi-intensive farms is located in Yangon and the Ayeyarwaddy Delta Region, Ngwe Saung in particular. Production of fresh water prawns also takes place at a relatively small-scale at integrated rice-fish farms, an aquaculture technique that is beneficial for smallholder farmers.

- White shrimp (Vannamei) production is based in the Tanintharyi Region.

Since the collapse of white shrimp culture more than a decade ago, priority has been placed on freshwater prawns. The current key export markets are China, Thailand, Japan, EU, and the United States. According to industry experts, export opportunities for shrimp are growing, given the rising global demand and Myanmar's close proximity to key consumer markets such as China.

The biggest challenge in the shrimp culture sub-sector lies at the earliest stage of the value chain: ensuring sufficient supply of shrimp seed. Myanmar had 26 hatcheries in 2006, including backyard hatcheries, but many of them have ceased operations since getting sufficient supply of broodstock from the Bay of Bengal and Andaman Sea has become a challenge. Thus, according to the Myanmar Shrimp Association (MSA), there are only about seven shrimp hatcheries in the country: five for freshwater culture and two for coastal culture. More than 90 percent of broodstock is being imported, largely from Thailand. According to official DoF figures, Myanmar imported 138.7 million giant freshwater prawn, tiger shrimp, and white shrimp larvae from Thailand in 2018. The state-owned shrimp/prawn hatcheries under the DoF only produced 12 million larvae that year, making imports 11.5 times larger than local production. There are no data available on private hatchery production, but private sector players such as Yuzana company are exploring possibilities for producing white shrimp broodstock locally.

CRAB

Crabs – both mud-crabs and value-added soft-shell crabs – accounted for 6 percent by volume and 21 percent by value of the top ten fisheries exports in 2018-2019, according to official DoF statistics. Most soft-shell crabs go to export markets, as domestic consumption is relatively low compared to mud crabs. Mud-crab exports go to China, Thailand, Singapore, and Korea; soft-shell crab is exported to Australia, the United States, EU, Japan, China, Hong Kong, and Korea. According to FAO statistics, between 2003 and 2015, the worldwide production of soft-shell crab more than doubled, from 151,900 to 344,100 tons, 80 percent of which was produced by China (the vast majority), Vietnam, Myanmar, Singapore, Indonesia, and Philippines.[16] FAO data also suggests that Myanmar produced around 2,800 tons of soft-shell crab in 2016. The largest producer and distributor of soft-shell crabs in the world is the Myanmar company Aung Moe Khine Co., Ltd, which has monthly production of more than 40 tons that are primarily exported to Singapore, Malaysia, Vietnam, Thailand, Hong Kong, China, and Taiwan.[17] Soft-shell crab production, in particular, has been receiving a lot of interest from aquaculture producers as it fetches a higher price, almost double than that of mud-crabs. Export potential is also growing, with increasing demand and interest from countries like Australia.

Soft-shell crab is cultured in brackish water, and production facilities are located in Kyauk Tan of Yangon Region, Ayeyarwaddy Region, Myeik in Taninntharyi Region, and Rakhine Region. Mud-crabs used to be predominantly captured from the wild, from mangroves in the Rakhine and Ayeyarwaddy Delta Regions, for both domestic consumption and export; juvenile crabs were set aside for soft-shell crab production. However, due to overexploitation over the years, the supply of mud-crabs in the wild has become limited. Realizing the need for maintaining an adequate and sustainable supply of mud-crabs for soft-shell

16 Barbalho Hungria, Diogo. "Global Status of Production and Commercialization of Soft-Shell Crabs." Springer International Publishing. July 2017. https://gia.org.br/portal/wp-content/uploads/2017/11/10.1007_s10499-017-0183-5.pdf
17 Ibid.

crab production, the DoF places restrictions on wild capture from time to time. Even so, the supply of mud-crab seeds produced by local hatcheries remains insufficient.

According to official data from the EU and the German Ministry for Economic Cooperation and Development-funded Myanmar Sustainable Aquaculture Programme (MYSAP), more than 134 million crabs are collected from the wild annually. The sub-sector has been placing a focus on developing mud-crab hatcheries to substitute the natural supply that has become limited over time. The first mud-crab hatchery was established in 2009 by DoF. MYSAP has also supported the establishment of a mud-crab hatchery in Labutta Township, Ayeyarwaddy Region in April 2019, which is operated by Texchem, a Malaysian firm with extensive experience in artificial mud-crab breeding. Nonetheless, since mud-crab seeds production in Myanmar is still nascent, the majority of soft-shell crab production facilities are still sourcing wild caught crablets. DoF, in collaboration with industry players, is supporting local hatcheries to acquire required knowledge and tools.

SEAWEED

Myanmar is endowed with rich and varied seaweed flora resources. Although Burmese consume several types of seaweed as vegetables and uses it as a source of agar extraction, seaweed has not been an important part of the sub-sector. More than 800 rocky islands along the Rakhine Coastal Region and the Myeik (Mergui) Archipalago along the Tanintharyi Coastal Region are the most suitable habitat for seaweed flora.

Unlike other sub-sectors, seaweed marine-culture receives minimal attention and support from both the public and private sectors, leaving it underdeveloped. Data on detailed estimates of seaweed reserves that can be sustainably extracted from natural seaweed beds are not available. Information on the overall condition of the seaweed sub-sector is also lacking. The Marine Science Departments of the Mawlamyaing University and Myeik University are pioneers working on the preservation and development of the seaweed sub-sector in Myanmar, but due to limited resources, little has been achieved. There is no national level strategy on the seaweed sub-sector nor dedicated projects that would foster its development.

In 2005, world seaweed production totaled 14.7 million tons, of which the culture sector contributed 13.5 million tons. By 2015, that number had doubled to 30.4 million tons, with the culture sector responsible for 29.4 million tons. The main producers in Asia are China, Indonesia, Malaysia, Thailand, and the Philippines. The top importers are China, EU, Japan, and the United States, which in total imported more than 520,000 tons in 2016.[18] While carrageenan production from seaweed is a large industry globally, there is a lack of processing industry in Myanmar despite rich seaweed resources. Given the lack of technology for mass production of ager-ager or carrageenan for export and the lack of demand from the domestic market, most seaweed beds still remain unexploited. In addition to the lack of local processing industry, a continuous fall in production of certain species, such as the red and brown seaweed (for example *Eucheuma* and *Cottonii*) that are suitable for commercial cultivation, limits the growth of the sub-sector. Over the past few years, seaweed cultivation in the Myeik Archipelago has declined as these seaweed species became endangered due to ice-ice disease outbreaks. This has

18 FAO. "The Global Status of Seaweed Production, Trade and Utilization." FAO. 2018. http://www.fao.org/in-action/globefish/publications/details-publication/en/c/1154074/

ultimately forced many farmers to abandon seaweed cultivation, with the majority of farmers returning to fisheries.

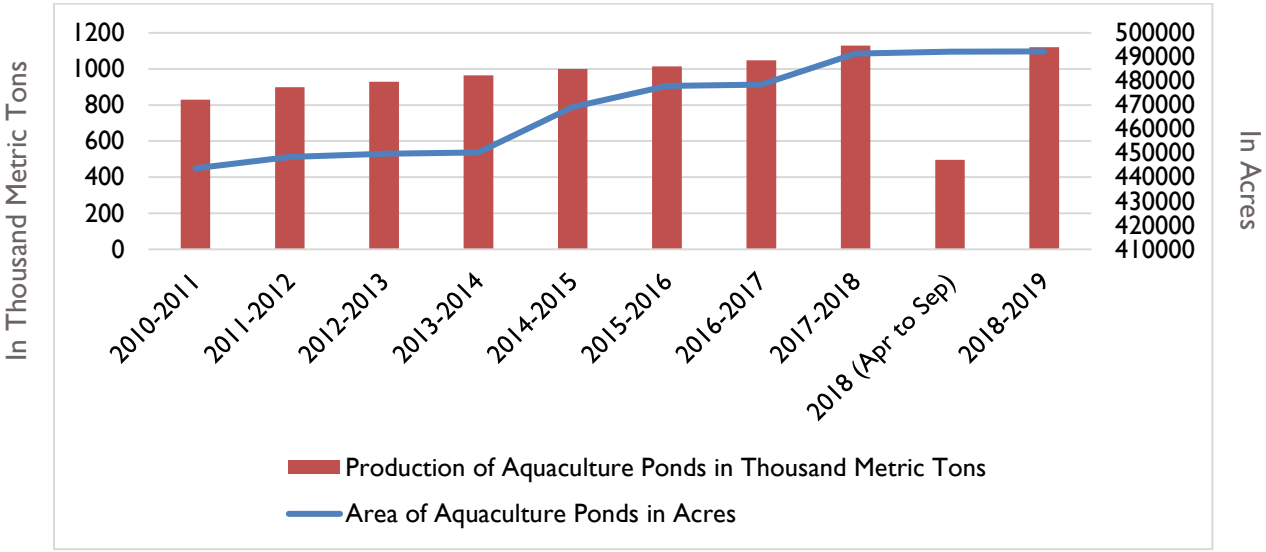
The Korean-based MSC Company has invested in the sector since 2007, operating marine-culture of *Cottonii* in the Myeik Archipelago through contract farming arrangements with the local farmers. As *Cottonii* has become scarce locally, cultivars are being imported from Indonesia. From 2008 to 2015, the company performed well, with about 100 tons of *Cottonii* produced and exported annually to Korea. However, due to the disease outbreak and the attack of predators, production has been gradually declining, with only 40 tons exported in 2019. Although the company had ambitions for extensive scale cultivation and even establishing a local integrated carrageenan processing plant, after confronting operational challenges, the company scaled down its activities, leaving many farmers to abandon seaweed cultivation. The company is now working with only ten contract farmers, providing them technical assistance and constant monitoring of cultivation. Currently MSC is pilot testing the potential of substituting *Cottonii* with *Gracilaria* production.

2.2. Key Figures and Geographic Footprint of the Sector

2.2.1. Farm Area and Production Data

According to DoF official statistics in the National Aquaculture Development Plan, in 2018-2019, aquaculture utilized an area of 487,328 acres (197,299 hectares), which has been steadily increasing along with the aquaculture production. However, according to NES, aquaculture in Myanmar still occupies less land than in the neighboring competitor countries such as Vietnam (more than 1 million ha) and Bangladesh (around 0.8 million ha). In 2018-2019, Myanmar produced 1.1 million MT of aquaculture products.

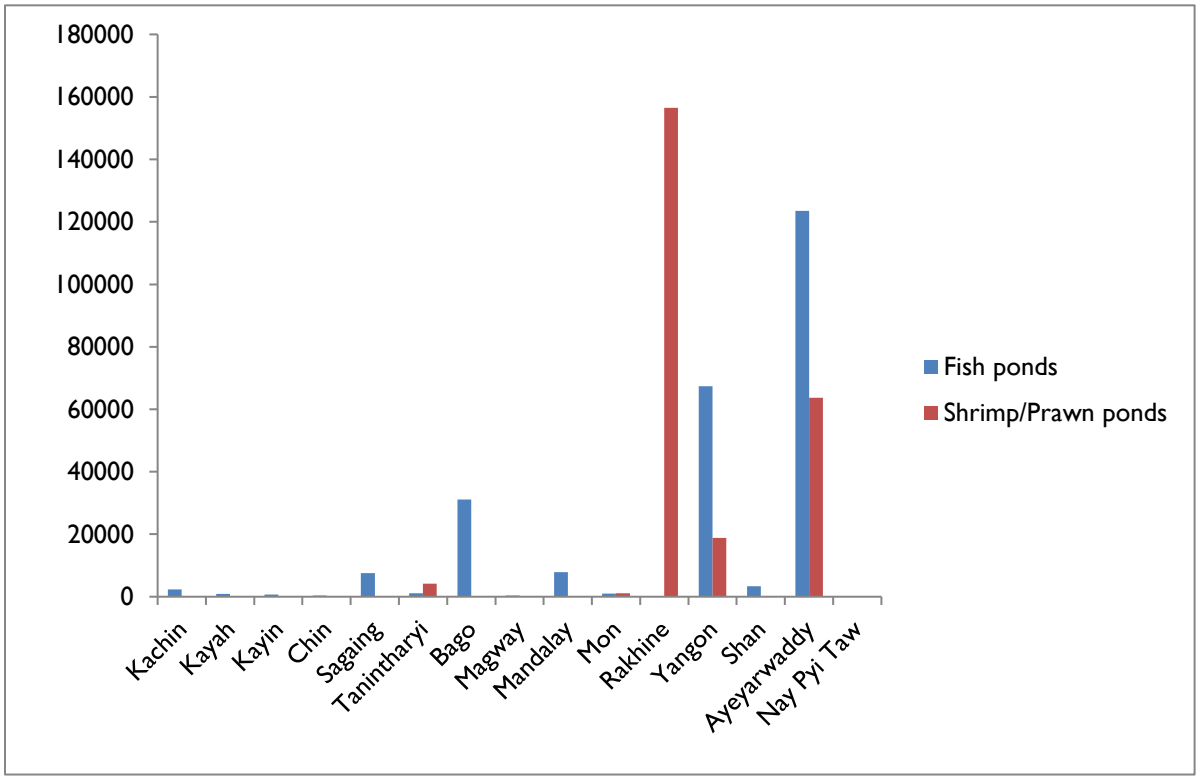
FIGURE 4: TOTAL AREA AND YEARLY AQUACULTURE PRODUCTION (ACRE, THOUSAND METRIC TONS)



Source: Department of Fisheries Statistics 2019

Nearly 94 percent of fish farms in Myanmar are located in Yangon, Bago, Rakhine, and Ayeyarwady Regions. The heaviest concentration is within Ayeyarwady Region and Rakhine State, which represent over 72 percent of all aquaculture ponds in terms of area. Ayeyarwaddy Region accounts for the highest number of fish ponds, while Rakhine Region has the largest number of shrimp ponds.

FIGURE 5: AQUACULTURE PONDS BY REGIONS AS OF 2018-2019 (ACRES)



Source: Department of Fisheries Statistics 2019

2.2.2. Employment

According to DoF statistics, in 2018, the total number of aquaculture farmers is 49,230, while the total permanent labor force in the sector, excluding daily-wagers and informal family workforce, was 59,518. WorldFish data suggests that total employment in the sector is 3.2 million, made up of 800,000 full-time and 2.4 million part-time workers.[19] In 2017, the Food Security Program, jointly undertaken by Centre for Economic and Social Development (CESD), Michigan State University, and the International Food Policy Research Institute (IFPRI), published the results of its Myanmar Aquaculture-Agriculture Survey, which found that aquaculture operations require approximately four times more person days of labor per acre than conventional crop farms. This is partially reflected by the nature of aquaculture operations, which have a more constant demand for labor, whereas crop farm labor demand is very seasonal. In addition, average daily wages at aquaculture farms were 27 percent higher than crop farms.

19 WorldFish Myanmar. https://www.worldfishcenter.org/country-pages/myanmar

According to the Myanmar Aquaculture-Agriculture Survey published in 2017, women's participation in the sector only contributes to 20 percent of total employment. Interviews with stakeholders on the ground, however, indicate that women's participation is significantly higher, especially in farming and post-harvest activities, although it cannot be specifically quantified. The survey also revealed that women earn only three-quarters of what their male counterparts earn. The multiplier effects of aquaculture development on employment are significant, as according to the National Aquaculture Development Plan, a rapid assessment of aquaculture sector in Ayeyarwaddy and Yangon Regions estimated that for every person employed in aquaculture operations, four people are employed in related activities, including processing and marketing industries.

2.3. Current and Emerging Trends Driving the Growth of the Sector

As the fisheries sector is increasingly shifting toward aquaculture, the aquaculture sector has been going through a number of improvements, and is receiving increased attention from the public and private sectors. Recent trends and development include:

- **Increased focus on diversification and product development.** There is a growing interest from the private sector in diversification and product development to tap into new more lucrative market opportunities. For example, rohu and carp are the most common fish species in Myanmar that have traditionally been cultured at scale. Local production of species with high export potential, such as tilapia and pangasius, remains relatively nascent. There is also a need to promote value-added processing by developing products such as fillets, collagen, and snacks, rather than just dried fish, which is the most common form of value-addition currently. However, diversification and product development initiatives are still minimal given the technical and financial limitations.
- **Growing awareness of export market requirements.** There is also growing awareness of market requirements and their importance. However, only a limited number of players have been able to increase their compliance with global market requirements, and the majority of players have limited knowledge and the capacity to implement more sophisticated quality management systems and practices.
- **Development of the inputs industry.** Inputs, especially feed production, has started to develop since 2003, when local production of formulated feed started to substitute for imports through establishment of new facilities as well as extension and upgrading of existing facilities. The sector has come a long way from importing all fish seeds, fry, and fingerlings, to significant and, for some, complete reliance on domestic production from local hatcheries and nurseries. However, shrimp seed production still relies heavily on imports as domestic hatcheries lack the capacity to produce the required varieties of species and at scale. Aquaculture farms in Myanmar have traditionally relied on self-formulated conventional feed by mixing rice bran, corn, oil cake, etc. As farms come to realize the importance of systematic feeding and the benefits of formulated feed, many started switching to that option. However, formulated feed in Myanmar is either imported or comprised of expensive reimported raw materials, and is thus relatively more expensive (by about 30 percent) than feed found in markets in Thailand and Vietnam. Local companies produce both sinking and floating pellet feed. Sinking pellet makes up the majority given its relatively low cost. Floating pellet, despite offering more advantages, is about 20 percent more expensive. Because full use of formulated feed is cost-prohibitive for many

aquaculture producers, a significant number of farms use a combination of formulated and conventional feed. Only about 30 percent of farms can afford to use formulated feed; about 40 percent use a mixture of formulated feed and conventional feed. Since there is relatively low usage of formulated feed, many farms have suboptimal post-larvae survival, fish size, productivity, and compliance with nutritional requirements.

- **New private sector initiatives.** Realizing the need for collective approach to fuel the development of the aquaculture sector, MFF has embarked on a large integrated aquaculture complex development in Pantanaw, Ayeyarwaddy Region, to focus on extensive and integrated production of top export species, such as *Pangasius*, targeting markets in China and the United States. The objective is to create synergies among the value chain players and increase competitive advantage by lowering transaction and production costs through economies of scale. The project is in the early stages of development, and some sector stakeholders have expressed concerns over limited benefits to small and medium-sized producers, as the project is currently focused on a limited number of large players.
- **Increased need for development of processing and cold storage facilities.** Fisheries products targeted for the domestic market do not need sophisticated post-harvest handling and processing. These products are cleaned, chilled in the cold room, and/or layered in ice for transfer to local markets. Most of the time, only chilling is needed as domestic end-consumers perceive that freezing takes away the freshness of the produce. For fresh fish export, both freezing and chilling are needed, so produce is frozen first and then moved to the cold room for storage before export. Some of the produce is exported in a semi-processed form, such as breaded shrimp and head on/off shrimp. Processing and cold storage facilities also serve as exporters. Several processing factories are located in Yangon, Tanintharyi, Rakhine, Ayeyarwaddy, Mon, and Shan. However, the limited post-harvest processing options and the absence of cold chain infrastructure throughout the country limit opportunities for value-added production and higher sector revenues. According to official DoF statistics, there are 123 processing and cold storage facilities in the country for all kinds of fisheries products, and more than 70 of these are concentrated in Yangon. Many of the facilities are in poor condition. Exports to the EU market must be processed and stored at EU-certified facilities. In order to obtain EU certification, cold storage and processing facilities must meet minimum standards, including, but not limited to, water quality and treatment, hygiene, and environmental guidelines.

2.4. COVID-19 Impacts

COVID-19 impacts on the sector are significant, affecting all stages of the value chain across all the sub-sectors. They include:

- **Reduction in sales in both export and domestic markets.** Sudden fall in demand has led to an oversupply of fresh products, leading to a general drop in prices. This has had a ripple effect on cash flow, making many producers and processors unable to meet financial obligations to their suppliers. San Pya and Thiri Mingalar markets, the largest wholesale markets for Lower Myanmar, where aquaculture produce from Yangon, Bago and Ayeyarwaddy regions is sold, handled 500,000-600,000 tons of fish, shrimp, and crabs daily before the pandemic. As a result of the pandemic, the volume has decreased to 200,000 tons a day.

- **Rejection of exports and order cancellations**. Aquaculture exports started to get rejected as COVID-19 cases increased. For example, Chinese officials detected six positive COVID-19 cases after swabbing the walls of a storage container that carried frozen Ecuadorean shrimp.[20] Exports from Myanmar were also rejected when the country saw a surge in the number of cases.
- **Supply chain disruptions.** The government enforced strict travel restrictions across cities and even townships in some regions, bringing intercity logistics and movement of goods to a complete stop.
- **Operational challenges.** Several processing plants, especially in Yangon, faced operational challenges as a temporary shutdown took place, without clarity on the resumption of business activities. While working from home is possible for some businesses, the closure of aquaculture processing factories brings a halt to their business functions. With the closure of factories, laborers returned to their towns or villages in other regions, and with the sudden announcement of lockdowns and travel restrictions, many were unable to return to work once the factories were approved to open. Many farms have postponed their harvests, but plan to resume once demand picks up again.
- **Increased storage costs.** Due to the suspension of exports and as supply has outstripped demand in domestic markets, the period when producers and exporters have to store their produce in cold storages has increased, ultimately raising storage costs. According to a cold chain operator interviewed, Myanmar would need about 200 facilities in order to match the current demand, well more than the current 123.

20 The Fish Site. "Ecuador Says that Shrimp Exports to China Are Back of Track after COVID-19 dispute." August 12, 2020. https://thefishsite.com/articles/ecuador-says-that-shrimp-exports-to-china-are-back-on-track-after-covid-19-dispute

3. END MARKET ANALYSIS

3.1. Key Export and Domestic Markets for Myanmar Aquaculture

3.1.1. Export Markets

According to Allied Market Research, the global market for aquaculture was valued at USD 285 billion in 2019 and is projected to grow to USD 378 billion by 2027.[21] Myanmar's fisheries sector has experienced strong growth over the past years as a result of concerted efforts by both the public and private sectors. Official data from the Ministry of Commerce shows that Myanmar's fisheries exports grew significantly within a year – from USD 722 million in 2018-2019 to USD 847 million in 2019-2020.[22] However, as noted earlier, data on the share of aquaculture products in total fisheries exports are not available. Processing in Myanmar is relatively modest due to underdeveloped processing industry; only about 20 percent of the exports are processed items according to MFF. These include dried fish, breaded shrimps/prawns, and head-on/off frozen shrimps.

Stakeholder interviews indicate the that top export items include rohu, carp, tilapia, shrimp, crabs, and lobsters. This is somewhat different from the official statistics on the top exported products provided by DoF (Table 1). However, it is clear that Myanmar's exports are dominated by selected species that have traditionally been produced. To expand market access to other higher value markets, the need for diversification becomes significant. Thus, stakeholders started testing new species that are in high demand in both export and domestic markets and are produced at relatively small scale at present, such as vannamei white shrimp, striped catfish (*Pangasius*), and tilapia.

TABLE 1: TOP 10 EXPORTED FISHERIES PRODUCTS (2018-2019)

SPECIES (COMMON NAME)	VOLUME IN METRIC TONS	VALUE IN US$ MILLION
Rohu	57,783.525	58.621
Fish Meal	44,057.24	43.106
Live Mud-Crab	11,552.501	36.621
Soft Shell Crab	3,042.401	33.390
Ribbon Fish	19,056.456	32.809
Live Eel	8,661.579	31.022
Hilsa	10,076.210	26.945
Squid	14,918.917	23.841
Trash Fish	72,118.758	23.109

21 Kumar, Sumesh, and Roshan Deshmukh. "Aquaculture Market by Environment and Fish Type: Global Opportunity Analysis and Industry Forecast, 2021-2027." Allied Market Research. November 2020. https://www.alliedmarketresearch.com/aquaculture-market

22 https://www.mdn.gov.mm/en/fishery-exports-soar-over-847-mln-2019-2020fy

SPECIES (COMMON NAME)	VOLUME IN METRIC TONS	VALUE IN US$ MILLION
Pink	9100.652	22.075

Source: Department of Fisheries

Key export markets for Myanmar fisheries products are China, Singapore, Thailand, Japan, the United States, and Middle Eastern and European markets. Buyer requirements vary by country, but typically buyers require Hazard Analysis and Critical Control Points (HACCP) certification for cold chain and processing facilities and Good Aquaculture Practices (GAqP) certification for producers. Higher value markets, such as those in the United States and EU, have more rigid requirements, which are out of reach for most Myanmar producers and processors, and the majority of exports go to markets with less stringent requirements. Out of approximately 120 cold storage facilities in the country, only 20 meet EU standards. In order to export to the EU market, produce can only be processed and stored at EU-certified facilities, which need to meet specific criteria such as installed water purification and waste water systems, which are often financially out of reach for processors. Since there is a limited availability of EU-certified facilities and to avoid high processing costs, some exporters have their produce frozen in a non-EU-certified facility and then moved to an EU-certified facility for storage in the cold room. This practice risks damaging the reputation of the sector. In addition, many processing and storage facilities in the country are in poor condition, lacking state of the art technology and infrastructure. Exports take place directly between the exporter in Myanmar and the importer in the end market, with no intermediaries involved, and direct linkages between exporters and importers are often formed at international seafood trade shows and expos.

Myanmar's competitiveness is relatively low compared to regional peers such as Thailand and Vietnam, as only a limited percentage of produce can meet buyer requirements. The lack of certifications and compliance to international standards and requirements keeps Myanmar's products at a disadvantage, compared to regional competitors, where the majority of facilities are HACCP, EU, and Halal certified. In addition, while the quality of Myanmar's traditional products, such as rohu, is on par with other exporters, the sector still needs to improve the quality of other species such as striped catfish, which are inferior to those produced in Thailand and Vietnam. Myanmar's striped catfish is smaller in size and has a yellowish color, while international buyers prefer white fish. This low level of competitiveness in international markets has led to fluctuations in demand for Myanmar's exports, and it is hard for producers and processors to plan their production. When supply exceeds export market demand, producers sell the excess in the domestic market, which leads to price collapse there.

Despite concerted efforts to enhance market access, many producers and processors struggle to meet market requirements due to financial and technical constraints. In addition, there is also a lack of government-to-government level agreements that would facilitate trade transactions between Myanmar and export markets. While in other countries like Vietnam, the government proves support to the sector to enhance market access and expansion, this support is missing in Myanmar. Larger companies with sound financial capability and good networks can work to access export markets, but farmers have limited understanding and knowledge of how to be qualified for GAqP certificates and require hands-on guidance.

3.1.2. Domestic Market

According to industry experts, 50-60 percent of total fish, shrimp, and crab production and 80 percent of processed fisheries products are sold in the domestic market. In the domestic market, wholesale markets in Yangon – Shwe Padauk Fish Market, San Pya Wholesale Market, and Thiri Mingalar Wholesale Market – serve as focal points for distribution for Lower Myanmar, while Strand Market in Mandalay serves as the hub for Upper Myanmar. Wholesale markets represent an important sales channel for aquaculture products in the domestic market and have been increasing their sales. Hundreds of trucks arrive daily at wholesale markets directly from farms in the nearby regions. According to a farm operator, before the pandemic, wholesale markets in Yangon alone handled an average of 500,000-600,000 tons daily of both captured and cultured fisheries products. The volume has gone down to 200,000-300,000 tons amidst the pandemic; demand from the hotel, restaurant, and cafe (HORECA) segment has plummeted, since they were forced to shut down as part of the government COVID-containment measures. There are approximately 500-600 wholesalers/retailers in Shwe Padauka Market and approximately 200 in San Pya Market, but due to lack of proper sales records at wholesale markets, the data on the overall sales at these markets are not available. In addition, DoF does not keep statistics of the overall size and growth trends for domestic aquaculture product market sales.

Wholesale markets supply all retail channels: HORECA, supermarkets, and fishmongers, who then retail the produce at small neighborhood wet markets. Consumers prefer to buy from fishmongers. Only the HORECA segment tends to have stringent quality requirements for freshness, size, cleanliness, and ice layering. Premium produce, often cleaned and properly packed, as well as frozen or processed products are typically sold in supermarkets, hypermarkets, and chain stores, which are collectively referred to as the modern channels. There is no price standardization at the wet market. The price is set by wholesalers based on the size of the fish and perceived freshness of the produce based on appearance. Domestic demand and volume of sales for processed fish products is still very low, and sale statistics are not available. Such products are only available in modern trade channels, and most of them are imported. Examples of locally produced processed fish products sold in the domestic market include frozen shrimp, breaded shrimp, shrimp or fish spring rolls, dried fish, etc.

Food safety is often overlooked in the domestic market. Although the Food and Drug Administration Department (FDA) of the Ministry of Health and Sports is responsible for overseeing the quality of food, drugs, medical devices, and cosmetics, not many efforts have been seen in safeguarding the safety of aquaculture products on the market. There is also a lack of other designated bodies for assuring strict compliance of food safety protocols at the market level. At the wet markets, food safety protocols are neglected. Due to the lack of storage space, it is a common to see fish scattered on tarpaulin sheets on the road or pavement, mixed with ice cubes to maintain freshness. End-consumers do not like frozen fish, believing that freezing is done only for non-fresh produce. During transport from farms to wholesale markets, food safety protocols are also not followed. While temperature-controlled box trucks are used, the air-conditioning is typically switched off to save fuel costs and only ice layering is used to retain freshness on the three- or four-hour drives. Consumers also have little awareness regarding the importance of food safety.

The lack of a market information system makes it hard for producers to study demand and price trends and make informed decisions on production planning, harvesting scheduling, and logistics planning to ensure that production and operation activities are well-aligned with market demand. If such a system

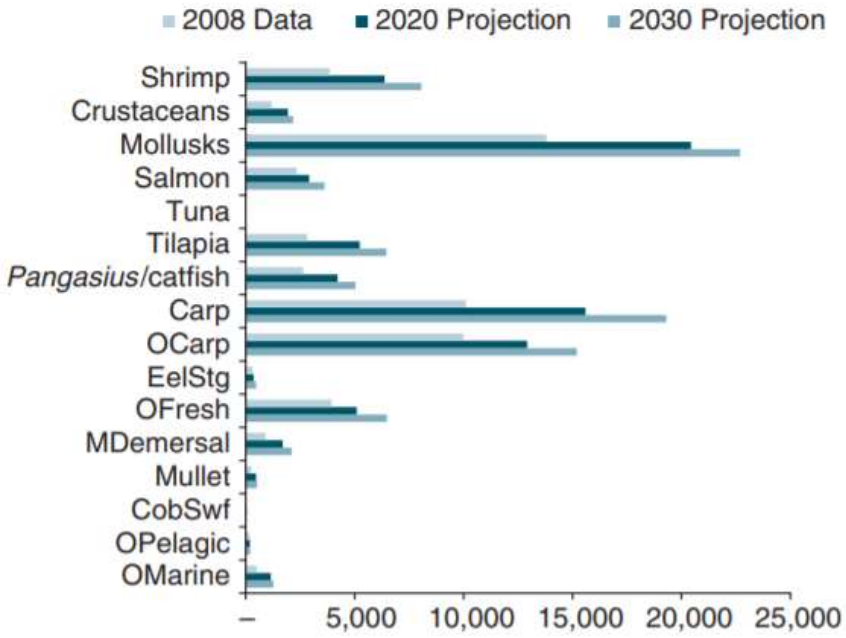
were in place, it would allow producers to study demand across different species in order to make informed and data-based choices on which species should be cultured for the upcoming season.

3.2. High-Growth Potential and High Value Market Opportunities

Increasing exports is a priority for aquaculture sector stakeholders, and they identify the following strategic opportunities for growth:

- **Diversifying products.** There is high potential for diversification from low-value fish such as rohu to high-value fish such as catfish, tilapia, and pangasius. According to producers, tilapia and pangasius have growing demand in both the export and domestic markets. However, the challenge lies in the upstream stage of the value chain as local hatcheries do not have access to sufficient broodstock of these higher value species to hatch locally. In terms of contribution to total production globally in 2018, pangasius, tilapia, and rohu made up 4.3 percent, 1.9 percent, and 3.7 percent, respectively. Vannamei white shrimp make up 52.9 percent of total crustacean production globally. According to FAO, the fastest growth in production globally is expected for tilapia, carp, and pangasius, as well as shrimp. Global tilapia production is expected to almost double, from 4.3 million tons to 7.3 million tons between 2010 and 2030.[23] Myanmar extensively produces rohu, however, despite its significant share (23 percent) in total production of fish, there is little demand for rohu fish from high-value markets.

FIGURE 6: PROJECTED GLOBAL AQUACULTURE FISH SUPPLY BY SPECIES (THOUSAND TONS)



Source: FAO[24]

23 World Bank and FAO. "Fish to 2030, Prospects for Fisheries and Aquaculture." December 2013. http://www.fao.org/3/i3640e/i3640e.pdf
24 Ibid

- **Accessing higher value markets.** Market access to high value export markets can be enhanced through compliance with international market requirements at each stage of the value chain, diversification into high value products, and effective market outreach programs. Firms need a lot of technical and financial support in enhancing compliance and diversification as well as guidance in penetrating new markets. Farms wanting to export need to be able to comply with GAqP certification requirements. In addition, MFF notes the need for increased participation in international seafood trade shows and expos, although at the moment producers and exporters have limited opportunities to attend due to high travel costs. For tilapia and pangasius, the key high value market will be the United States. For shrimp, major global markets are China, Denmark, India, Indonesia, Netherlands, Norway, Vietnam, Canada, Iceland, Malaysia, Mexico, and the United States. Myanmar has been exporting only to a handful of countries, including China, Thailand, and the EU markets, so for shrimp, there are still many markets that Myanmar could tap.[25]
- **Increasing value addition.** Industry stakeholders such as the MFF believe that there is market demand and potential for developing processed higher-value products, such as fish fillets, snacks, and collagen. This will require increased access to technology and finance for processors.

25 Ibid

4. STRUCTURE OF THE SECTOR AND KEY SUB-SECTORS

4.1. Key Value Chain Players

4.1.1. Feed Suppliers

According to the Myanmar Aqua-Feed Association, there are 17 feed producers in the country, including a handful of foreign players such as CP, Green Feed, De Heus, New Hope, and CJ. All the feed mills are located in and near Yangon. In addition to formulated feed factories, some farms have backyard feed mills for their own use. Local companies have been able to compete with foreign players, producing both sinking and floating pellet feed.

4.1.2. Producers

There are three types of farms at the production level: hatchery, nursery, and grow-out farms. Hatcheries focus on breeding, hatching, and rearing through the early stages of fish and crustaceans. They source broodstock from DoF operated hatcheries. For species where broodstock is limited locally such as catfish, pangasius, and white shrimp, broodstock is imported from Thailand. Nursery farms source the fingerlings from the hatcheries and raise them for subsequent transfer to grow-out farms. Grow-out farms capture the output from the nurseries and then culture them until they reach the desired size. While the majority of farms have a specific focus, depending on their expertise, there are also integrated players operating all types of farms. Farms do direct sourcing of fries and fingerlings, either from DoF or private hatcheries. There is no intermediary involved. Production is distributed to wholesale markets, from which further distribution to the end-markets takes place.

4.1.3. Processors and Cold Storages/Exporters

After harvest, farms that sell to domestic markets do not go through much value-addition. The harvested produce is ice-layered and sent to the wholesale markets, either using in-house trucks or third-party truck services. At times of excessive supply, some farms dry their fish.

For farms targeting export markets, produce is sent to processing and cold storage facilities. These facilities also serve as exporters. Processing in Myanmar does not require include sophisticated processing, and facilities lack technical and financial capacity to produce high-value processed items such as fillets, snacks, and collagen. Most of the time, produce is exported in raw or semi-processed form. Raw shrimp is exported as head-on and headless; some facilities produce ready-to-cook items such as breaded shrimp.

4.1.4. Off-Takers

Exports take place right after processing and cold storage, and are sold directly to importers in end markets. For distribution to domestic markets, wholesale markets are the focal points from which distribution to different channels takes place. Wholesale markets supply directly to HORECA, as well as off-takers such as supermarkets, hypermarkets, chain stores, and fishmongers, who sell directly to consumers.

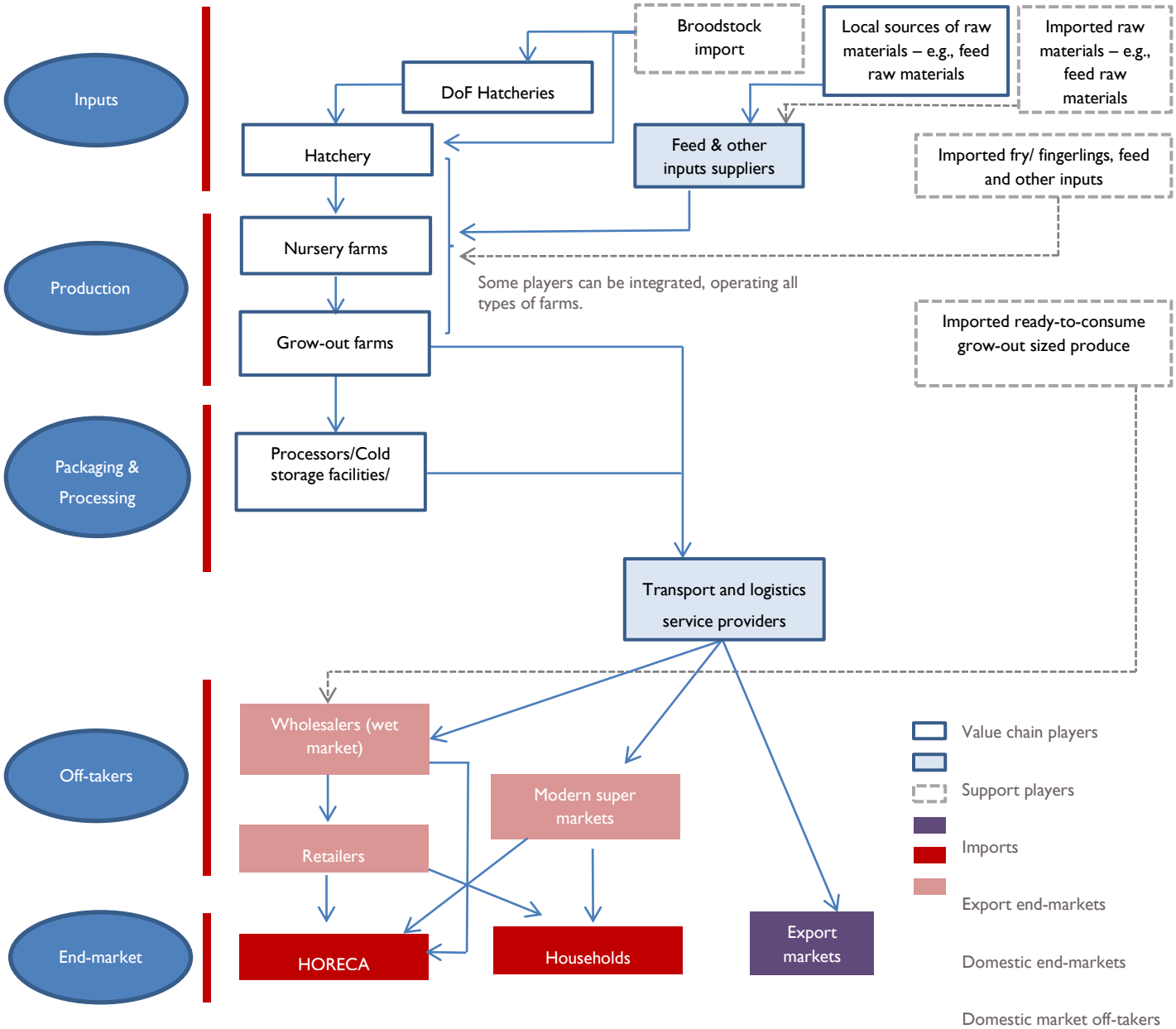
Table 2 provides examples of significant players in the sector in each category.

TABLE 2: KEY VALUE CHAIN PLAYERS

TYPE OF PLAYERS	ESTIMATED NUMBER OF PLAYERS	KEY PLAYERS
Feed Suppliers	There are 17 feed producers in the country, excluding small backyard feed mills.	Myan Swan Htet (Local player) Htoo Thit (Local player) CP De Heus CJ New Hope Green Feed
Hatcheries	There are 70 hatcheries in total, out of which 27 are state-owned hatcheries operated by DoF. There are only seven or eight shrimp/prawn hatcheries.	DoF hatcheries Hlawgar hatchery U Hla Htay hatchery Maubin hatchery
Nursery Farms and Grow-out Farms	There are no data available on the number of nursery and grow-out farms. Aquaculture production areas make up a total of 491,345 acres.	Yuzana Asia Thar Shwe Yamone U Nanda Shwe Grow-out farm U San Htike
Processing & Cold Storage Facilities/Exporters	There are 123 processing and cold storage facilities in the country. More than 70 are concentrated in Yangon. Twenty-seven have been approved to export to EU member countries; 33 have registered to export to Vietnam; 94, including dried fishery product warehouses and chilled product stations, have been registered to export to China.	Shwe Yamone Yuzana U Kyaw Naing
Off-Takers	The key wholesale channels are Shwe Paduak and San Pya Fish Markets, from which all aquaculture produce is distributed to domestic and export markets. There are approximately 500-600 wholesalers/retailers in Shwe Padauka Market and approximately 200 in San Pya Market. In the modern trade channel, both local and foreign-owned players operate retail and wholesale chains in metropolitan areas like Yangon, Mandalay, Nay Pyi Taw, and other commercial hubs.	Traditional channel – Shwe Padauk, San Pya Fish Markets Modern trade channel – City Mart, Sein Gay Har, Ocean, Market Place, Asia Light, Super One, Makro, Metro

4.2. Aquaculture Value Chain Map

FIGURE 7: AQUACULTURE VALUE CHAIN MAP



4.3. Key Ecosystem Actors

TABLE 3: KEY ECOSYSTEM ACTORS

CATEGORY	ECOSYSTEM ACTORS	OVERVIEW OF THE ACTIVITIES
Government	Department of Fisheries, Ministry of Agriculture, Livestock and Irrigation Department of Trade, Ministry of Commerce Livestock Breeding and Veterinary Department, Ministry of Agriculture, Livestock and Irrigation Fisheries and Aquaculture Department, Yangon University	Regulating relevant business activities in the aquaculture sector Drafting and enforcement of relevant regulatory framework Coordination across Government agencies for promoting the sector Operating of state-owned facilities, e.g. hatcheries, laboratories, research centers, etc.
Associations	UMFCCI Myanmar Fisheries Federation Myanmar Shrimp Association Myanmar Aqua-Feed Association Myanmar Fisheries Producers Processors and Exporters Association Myanmar Fish Farmers Association Myanmar Crab Entrepreneurs Association Myanmar Eel Entrepreneurs Association Myanmar Ornamental Fish Entrepreneurs Association Myanmar Fish Paste, Dried Fish, Fish Sauce Entrepreneurs Association Universities – Yangon University	Sectorial associations that act as the voices of the businesses and enable public-private sector coordination and collaboration, lobbying and advocacy for the development of the sub-sectors.
Business service providers	-	There are no dedicated professional players helping aquaculture players with business support services. Aquaculture players get support from associations, NGOs, INGOs, development partners, and DoF.
Training providers	Department of Fisheries NGOs, INGOs listed under the NGOS, INGOs, and development partners category Foreign governments and experts	Provide training and capacity enhancement programs under dedicated themes – e.g. farm productivity enhancement, women's empowerment, etc.
Financial service providers	BRAC Microfinance Institute Ar Yone Oo Microfinance Institute Global Treasure Bank Informal lending sources	Microfinance players provide financial assistance to micro and small farms. Global Treasure Bank provides collateralized bank loans. Informal lending also tends out to be a common source of finance given the limited reach and available of formal instruments.

CATEGORY	ECOSYSTEM ACTORS	OVERVIEW OF THE ACTIVITIES
NGOs, INGOs, contributors, and development partners	MYSAP – Myanmar Sustainable Aquaculture Program from 2016 to 2022 in Ayeyarwaddy Delta and Central Dry Zone, Rakhine and Shan Regions GIZ – Myanmar Sustainable Aquaculture Program WorldFish – Improving Fishery Management in Support for Better Governance of Myanmar's Inland and Delta Fisheries, particular focus in Ayeyarwaddy Delta and Central Dry Zone, the Development of Rice-Fish System in Ayeyarwaddy Delta Region; Implementing the Fish for Livelihoods Activity for USAID (see below) Norway Development Group – Supporting marine cage fish farming initiative in the Tanintharyi Region Centre for Economic and Social Development – Involved in drafting National Aquaculture Development Plan JICA – On-site trainings and financial assistance to aquaculture farms in collaboration with DoF ACIAR – Funded the project on Improving Fishery Management in Support of Better Governance of Myanmar's Inland and Delta Fisheries USAID – The Fish for Livelihoods Activity, implemented by WorldFish, works with small-holder aquaculture producers, and processors in increase production and incomes; and to enhance nutritional awareness and availability of food-safe fish. Supporting the modernization of the aquaculture sector through its partnership with University of Arizona and Yangon and Pathein Universities KOICA – Establishment of Freshwater Aquaculture Research and Extension Centre Japan International Research Center for Agricultural Sciences (JIRCAS) – Development of Sustainable and Environmentally Friendly Aquaculture techniques in coastal waters in Myanmar Food and Agriculture Organization (FAO) – Strengthening the adaptive capacity and resilience of fisheries and aquaculture-dependent livelihoods in Myanmar, with particular focus in Yangon, Ayeywarddy, and Rakhine Regions Thailand International Cooperation Agency (TICA) – Marine Shrimp Aquaculture Development in Rakhine State European Union – Allocating experts for providing trainings to processing and storage facilities on how to meet EU standards. Also consequently arranging tests to get those factories certified European Embassies – Providing financial assistance to exporters for joining international trade shows, e.g. Brussels Seafood Show, Dubai Seafood Show, etc.	Provide technical and financial assistance, trainings and capacity enhancement programs to players along the value chain, including DoF.

5. CONSTRAINTS TO TRADE AND INVESTMENT

Firms in the sector, regardless of the role they play along the value chain, face dire limitations that restrain their current operations and growth potential. These include access to proper knowledge and expertise, technology and tools, skills, and resources in the market, as well as a lack of financial resources or instruments.

5.1. Access to Markets

5.1.1. Poor Compliance with International Market Requirements

The majority of the players at each stage of the value chain have poor compliance with international market requirements. At the production level, farms lack GAqP certificates or the know-how to apply for them. At the processing stage, operators often lack EU certifications or the Food and Drug Administration certification for the U.S. market. This is a result of limited knowledge of the market requirements, few resources and capabilities to meet these requirements, and the lack of certification bodies available locally.

5.1.2. Lack of Product Diversification for Targeted Markets

Myanmar has been primarily focusing on selected species that the country has expertise in. Diversification initiatives to expand the current portfolio into products offering higher and more sustainable potential and benefits in targeted export and domestic markets are required, which will ultimately affect the sustainability, competitiveness, and robustness of Myanmar's aquaculture exports. In addition, a lack of market information systems puts farmers in a vulnerable position as they cannot make informed choices on production planning, harvesting, distribution, and marketing activities. At times of excessive supply or falling prices in the end-market, farmers make very little margin.

5.1.3. Lack of Quality Control and Food Safety Protocols

While strict enforcement and adherence to quality control is common practice in export markets, there is a complete absence of such measures in the domestic market. With the absence of standardized quality checks, price is determined only by visual appearance and size of the fish with no differentiation between products produced under good or poor farming practices. For example, while fish produced from pure fish farms should fetch relatively higher prices vis-a-vis the produce from chicken-fish farms from the food safety perspective, there is very little distinction in practice as price assessment by wholesalers is made superficially.

5.2. Access to Finance and Investment

5.2.1. Limited Available Financing Instruments

There is limited availability of financing instruments throughout the value chain, even as investment and financing needs vary by actor. The lack of sophistication of investment and financing instruments and the underdeveloped financing ecosystem ultimately limit sector growth and expansion.

TABLE 4: FINANCING NEEDS AND INSTRUMENTS AVAILABLE ALONG THE VALUE CHAIN

ACTOR	FINANCING NEEDS	AVAILABLE FINANCING AND INVESTMENT INSTRUMENTS
Inputs	Input suppliers have two particular challenges: 1) financing needs in accessing raw materials for inputs production; and 2) limitations in enhancing credit sales to customers due to the fear of default.	As input suppliers are larger with some ownership of collateralizable assets, they rely mostly on bank loans. Self-financing still makes up the highest contribution.
Production	At the farm level, financing is required for both working capital and growth capital. Farms need financing for better access to inputs, expansion of farm areas, upgrading farm infrastructure, mechanization of farm equipment and tools, diversifying into higher value species, better compliance to market requirements, and other standards that would mean better market access for them. Current input purchases are financed through savings, crop sales, and non-farm activities, whereas large farms are more likely to use credit.	For small- and medium-sized farms, microfinance loans are the most common and accessible financing instrument. However, the relatively low loan size solves financing needs only to an extent, and the loan tenure makes it hard for farms to meet repayment schedules as it is not aligned with the culture period. BRAC and Ar Yone Oo Social Development are some of the microfinance institutions active in the aquaculture sector. Banks like Global Treasure Bank also provide small loans per acre. Other than these traditional financing schemes, farms have little to no access to banks' collateralized loans as they do not have legalized ownership of collateralizable assets. High borrowing rates are also a hindrance.
Packaging & Processing	For processing, financing is needed for upgrading existing facilities, which are often in poor condition, as well as adding new facilities to expand the capacity.	Bank loans are the most common financing instrument besides self-financing and borrowing from informal sources, such as families and friends.
Off-Takers - Exporters	Exporters face cash flow challenges in managing between advances made to suppliers as well as payment received from importers.	

Investment and financing readiness are still lacking at the farm level due to limited understanding of the available instruments and the lack of resources and capability to comply with requirements. Farm readiness is particularly weakened by hurdles to legalizing their land ownership, which restricts their ability to use land as collateral. In addition, farms also lack proper business plans, financial control systems, and good governance, which disqualifies them from being considered for growth financing. They therefore only have access to small working capital loans provided by microfinance institutions. Private equity investors and impact investors have also shied away from the aquaculture sector due to higher risks.

5.3. Access to Production Technologies and Skills

5.3.1. Knowledge and Skill Gaps

Knowledge and skill gaps are observed throughout the value chain, but are more severe in the upstream activities at the farm level. While an increase in the number of hatcheries and their production has taken place over time, hatcheries have stagnated and not been able to grow as expected. With the change in export demand and the shift to higher value and short-culture period species, there is a need for diversification of commonly produced species. However, hatching new species requires import of sufficient broodstock from foreign countries, knowledge and skill transfer from international experts,

and upgrades in farm technology and facilities. While big players such as the Pantanaw Integrated Aquaculture Complex can afford to bring in foreign expertise and enter into foreign partnerships to expand production, the majority of aquaculture farms remain unable to expand.

For grow-out farms, the challenge remains in learning proper feeding techniques and farm management practices, as well as ways to get GAqP certified. Farms are also eager to embark on product diversification opportunities, although they are not yet well-equipped with the right knowledge and expertise to do so. They lack proper farm management practices, such as the correct use of fertilizers, biosecurity protocols, and correct feeding methods. This ultimately leads to problems of low productivity, high mortality rates, and poor-quality produce, which in turn limits access to high value markets. Lack of proper recordkeeping results in farms being unable to assess their productivity and financial viability. Poor financial management ultimately leads to farms making production and operations planning decisions without sound financial information, resulting in relatively low financial returns.

5.3.2. Lack of Advanced Technologies

Farms often lack the advanced technologies they need to enhance operations and foster further growth. For example, hatcheries lack the advanced water temperature control, water treatment, and purification systems required for certain species. Access to such technology is limited by low availability in the country as well as the high costs associated with adopting them. Even if such technology can be made available, farms need foreign experts to teach them how to make effective use of it as there is generally a lack of local expertise.

There is little mechanization at the farm level, particularly at micro and small farms with limited finances, so farms end up relying on manual labor for most of their activities, which ultimately affects overall productivity. While DoF has leasing services in some township offices, they are often in high demand and the coverage is very limited. Hire purchase schemes by private entities are available, but many micro and small farms struggle either to be eligible or to meet repayment schedules.

Access to water is also a challenge, as irrigation is often prioritized for rice production and the cost of using irrigation water for aquaculture per unit volume is higher. This leads to farms having to invest in other alternative sources of water, which ultimately drives up production costs. High tech alternatives for water access such as solar water pumps from Proximity Designs have limited reach, and agriculture is the priority sector.

Private hatcheries also need advanced facilities and technology. In order to diversify into other species, hatcheries need to be equipped with modern temperature control systems. There is a need for genetics improvement as well. Although DoF has a research facility, it is in poor condition, according to industry players, and its research is limited to a narrow spectrum of activities due to technical and financial constraints. Research and development initiatives taken to improve genetics and make upgrade are largely absent. This restricts Myanmar's potential in sustaining and improving the genetics of current commonly rasied species as well as diversifying into more lucrative species.

5.4. Business-Enabling Environment

5.4.1. Lack of Government Development Policies for Each Sub-Sector

Although a National Aquaculture Development Plan is being drafted, there is a lack of clear strategy on how the plan will be enforced. A dedicated central committee to guide sector development and foster better cooperation between government and private sector is missing. There is also an unbalanced focus among sub-sectors, as a large majority of the assistance programs are dedicated to fish culture in general, while the crustacean culture is left under-developed in many aspects, including market access, local seed production, integrated value chain development, enhanced productivity, adoption of better farming practices, and development of hatcheries for shrimp, prawn, and crabs.

There is also a clear lack of cross-sector government agency coordination. One of the primary reasons aqua feed price in Myanmar is relatively expensive is the heavy reliance on imports for its raw materials. This reliance is triggered by the limited availability of such raw materials locally as they are exported in raw forms by agricultural commodity exporters, leaving no room for local value-addition for aqua feed. Due to high feed prices, farmers cannot follow a systematic feeding method, which ultimately leads to poor quality and limits access to high-value markets. There is a need for cross-sector coordination between the DoF and Department of Agriculture on the export and domestic use planning of raw feed components such as corn, rice bran, and soy to ensure they are available locally at cost-effective prices.

The aquaculture sector also suffers the threat of parallel illicit imports, which the government has not made efforts to effectively control. Pangasius and shrimp are the most common species that are illegally imported from Thailand. Such imports are often rejected items, and are thus sold at prices lower than domestic supplies, creating unfair competition.

5.4.2. Difficulties in Obtaining Land and Land Tenure

Myanmar has very little leasable land allotted to the aquaculture sector, with the majority of the land made available to the agriculture sector, especially for paddy farms. In addition, the legal system for conversion of farmland or other types of land to aquaculture land remains highly complicated and bureaucratic. The costs associated with converting farmland into aquaculture land, as well as securing necessary land use certificates, are significant, often involving unofficial payments to expedite the process. In addition, the procedures have little transparency and standardization, and farmers see them as burdensome; they often give up expansion plans in order to avoid these complications and costs. On the other hand, there are many farms, especially in the remote non-urban areas, that are not legally registered and licensed with the DoF, although this means they are not eligible for DoF-led training and capacity enhancement programs, subsidies, and assistance programs.

TABLE 5: CURRENT LAND USE BY AQUA PONDS AND PADDY LAND IN ACRES (2017)

REGIONS	AQUA PONDS (ACRE)	PADDY LAND (ACRE)
Kachin	2,344	448,189
Kayah	893	95,180
Kayin	861	582,364

REGIONS	AQUA PONDS (ACRE)	PADDY LAND (ACRE)
Chin	296	82,852
Sagaing	7,580	2,130,224
Tanintharyi	5,258	254,780
Bago	31,186	2,960,455
Magway	425	748,299
Mandalay	7,873	643,999
Mon	2,126	734,365
Rakhine	156,509	1,113,159
Yangon	85,125	1,359,525
Shan	3,408	1,319,826
Ayeyarwaddy	187,287	5,037,199
Nay Pyi Taw	175	185,109
Total	491,346	17,695,525

Source: Department of Fisheries, Fisheries Statistics 2018

A new trend that has been seen at the farm level over the recent years is the entry of Chinese players who establish and operate large-scale farms either on their own or on leased land. They secure long-term land leases from aquaculture farmers who find renting the farmland much more attractive than operating on their own amidst rising production costs and highly uncertain returns. While the legal status of such Chinese farms remains unclear, they pose a significant threat and competition to domestic farms, with many of them selling on the domestic market and some exporting to China. Given their financial strength, they can afford to invest in infrastructure that is otherwise out of reach for the majority of local farms.

5.4.3. Limited Capacity of DoF

While DoF is the key player providing direct and indirect support to the sector, it faces limitations in terms of its capacity, resources, and reach. The limited technical and human resources dedicated for DoF's monitoring, control, and surveillance activities constrain its capacity to inspect and certify companies and farms in key production areas. There is a need for expansion of such inspection services to key aquaculture regions outside of Yangon to enable equitable development across regions. There is also an insufficient number of trainers at DoF for its audit and ongoing training programs. Private sector provision of such services is also hindered by the farms' inability to afford such services. DoF also needs a major upgrade in terms of its disease diagnosis and control capability in order to protect sub-sectors from experiencing a similar kind of collapse that the shrimp sub-sector faced years ago.

5.5. Transportation and Logistics Needs and Opportunities for Sector Growth

The sector has significant transport and logistics constraints. Cold chain logistics providers and infrastructure are still limited. Road infrastructure is also a challenge in that the majority of the roads, where they exist, are dilapidated; feeder roads connecting farms with main roads are often missing or cannot be used year-round, particularly in remote areas. Transportation from farms often takes place through multiple means, including trailers or motorcycles. Although box trucks are available for product distribution to domestic markets, proper refrigeration is not used in order to save fuel costs; only ice layering is used. With limited financing available to cover the high price of new trucks, logistics providers struggle to expand their businesses. All these factors add up to rising transport and logistics costs, especially during the peak season when demand from the agriculture sector soars.

A lack of proper and adequate storage space at wet markets and lack of cold chain infrastructure including refrigerated trucks to transport the produce are additional challenges. Processing and cold storage facilities face an unstable electricity supply, which requires facilities to have back-up generators. This, in turn, increases operating costs. While capital investments and growth capital needs are high for these facilities, a collateralized bank loan is the only source of finance available to them.

Access to conflict areas is often constrained due to the presence of armed groups. According to some box truck operators in the aquaculture sector, they have faced incidents where these groups solicit payments for driving into their territories, even though they fall under the Union Government's administration. Truck operators also avoid conflict areas such as Rakhine, demanding extra payment to drive there.

In the export context, lead time is often longer than expected due to complications in clearance procedures and other administrative delays and long waiting times at the port, which ultimately affects quality of the produce. Modernization of port systems and equipment is also needed. COVID-19 has also caused many transport and logistics-related obstacles. Businesses reported difficulties in both getting inputs and exporting products due to the reduced operations of logistics services. Lead times have become significantly longer, which increased business costs.

5.6. ICT Needs and Opportunities for Sector Growth

ICT needs in the sector are significant. The growing number of tech and start-up challenges and competitions has led to an increasing number of tech players. While there are several players in the agri-tech space, there are only two in the aquaculture sector: WorldFish's Shwe Ngar app and Greenway's Greenovator app.

Greenovator is an agri-livestock mobile platform developed by Greenway Social Enterprise. It is known to be the first and best agri-mobile app in Myanmar, which can be used not only by small-scale farmers but anyone throughout the value chain. This free app provides information, services, and data-driven solutions to address challenges on Myanmar's agriculture and livestock farms. It provides contents related to topics such as farming practices for GAqP compliance, weather information, daily crop/commodity prices in different markets, and tools to develop farming records and auto generate proper accounting records and profit and loss statements to help farmers to assess their financial performance. The app also has a feature where farmers can chat directly with technicians and experts. In addition to providing content, it also includes an online matching function connecting farms with input

suppliers and commodity buyers. The app now has more than 240,000 verified users. There are more than 10,000 input suppliers and traders registered, but only about 30-40 are actively engaged in commercial transactions through the platform.

WorldFish has just launched Shwe Ngar app, which will provide fish farming households with timely information on how to stock and feed fish, improve fish health, and learn about aquaculture technologies and nutrition, water, sanitation, and hygiene practices. The app will also connect farmers with suppliers and traders.

While it is undeniable that such apps offer significant benefits, their reach is still limited due to low digital literacy, and usually focused on the areas covered by donor projects. For example, Greenovator focuses only on MYSAP's priority areas. Mobile apps, regardless of the sector in which they operate, face funding limitations in Myanmar. Since most of the apps are provided free to users, commercialization opportunities are limited. While the apps have monetization plans for long-term sustainability, they are only in the early stages of operation and their financial viability in the long-run cannot yet be assessed. Many of the apps operate with grant funding; advertisement revenue makes a small contribution. Greenovator's monetization plan in the medium term is to charge a commission on the commercial transactions that take place on the platform. Digital payments in Myanmar have started to develop, however, user awareness and digital literacy are still very low. For the apps to start fully online e-commerce activities with digital payment options, significant user capacity building is needed.

There are number of opportunities for ICT solutions to enable the growth of the aquaculture sector:

- Mobile apps can be used to support market linkages and facilitate trade transactions. For example, Greenovator has an online market place in its app where input suppliers, producers, off-takers, and processors/exporters can register and list the products they are looking for or providing. Buyers and sellers can interact directly on the app, and e-payment options are available to facilitate the transactions.
- The majority of farms in Myanmar lack basic accounting and farm recordkeeping systems. Thus, enabling a quick tool in which simple and easy daily inputs can automatically be used to generate proper farming records and books will not only enhance farms' investment readiness but also allow them easy access to the basic economics of their production as the foundation for good financial management and production planning.
- Market information systems in the local context are almost non-existent. If daily market information can be disbursed to farmers through the apps, it will help them make informed choices in their operational activities.
- Such mobile platforms facilitate collaboration among various ecosystem players to support sector growth in a cohesive and integrated way.

6. INCLUSIVE DEVELOPMENT CONSTRAINTS

6.1. Women's Participation and Gender-Based Constraints

Women's involvement in aquaculture is significant, however, is seen as an extension of their domestic roles. While men are more involved in labor-intensive activities, women's participation is more prevalent in feeding and after-harvest activities: processing and marketing. However, there are also women involved in labor-intensive activities such as pond preparation and weeding. Women also play a role in financial management and are often well-acquainted with technology use. According to interviews with Proximity Designs and Greenovator, while user accounts might be registered under the names of the husbands, wives are found to be the real users of technology applications on the ground. Women are reluctant to assume leading roles due to social norms that portray the man as the head of family while diminishing the roles of women. Pay gaps exist at different stages of the value chain, with women making only three-fourths of men's wages in general.

Various ecosystem players are actively involved in promoting women's participation and empowerment in the aquaculture sector through targeted trainings and capacity building initiatives. For example, WorldFish conducted a study in the Ayeyarwaddy Delta and Central Dry Zone regions, where one of the aims was to gain an in-depth understanding of existing gender norms and social relations that may influence WorldFish's aquaculture development project outcomes. Based on the findings, gender-transformative approaches were developed that included trainings and capacity enhancement programs especially for women in aquaculture, which were delivered in selected townships.

6.2. Non-Urban Areas Participation and Related Constraints

While non-urban and economically marginalized areas receive some attention from public, private, and donor-led initiatives, conflict-affected areas are typically not on their radar due to security concerns. In conflict-affected regions, accessibility differs by township and depends on the level of intensity of conflict in the area. The majority of aquaculture business activities, especially farms, are located in the states of Rakhine, Ayeyarwaddy, Tanintharyi, Shan, Mon, and Sagaing. While Rakhine is generally known as a conflict-affected area, some parts of the state still provide opportunities for safe business operations. In some villages in the Shan Region, the majority of the farmers are former members of armed groups, but business operations continue at a normal pace with the presence of players like MYSAP due to relative regional stability. Often direct orders from the Union Government require development partners to avoid conflict-affected areas. The lack of basic infrastructure and limited access to information, finance, trainings, and capacity building programs put farms in those regions at a disadvantage limiting their growth.

A language barrier is also one of the challenges, particularly in remote areas in Shan and Rakhine, where Burmese is rarely spoken; this creates major communication gaps between farmers and buyers. While few organizations work in conflict-affected areas, a number of development partners are providing support to farmers in economically marginalized regions. For example, MYSAP is promoting rice-fish integrated farming for micro farms in the Inle Region and some conflict-affected villages nearby, primarily for household nutrition as well as for generating income.

7. RECOMMENDATIONS

7.1. Facilitate Foreign Investment in Promising Businesses

The Activity could invite potential foreign investors to visit growth-stage aquaculture companies to explore investment opportunities. Investment opportunities exist in processing businesses, hatcheries, large grow-out farms, feed manufacturing, and mega projects like the Pantanaw Integrated Aquaculture Complex. In addition to inviting foreign corporate and financial investors such as private equity firms, the Activity could also facilitate access for local businesses to investment readiness services to help prepare them to meet prospective investors.

7.2. Facilitate Access to Finance

The Activity could facilitate access to investment readiness services such as local accountants to help prepare the companies to access debt financing. In addition, the Activity could identify ways to facilitate the establishment of alternative financing schemes that would focus on the aquaculture sector, potentially via grants to support innovative business models and financing schemes that can be identified through a call for applications organized in collaboration with sector associations and other ecosystem players, such as GIZ and WorldFish.

TABLE 6: POTENTIAL FINANCING SCHEMES ALONG THE VALUE CHAIN

ACTOR	FINACING SCHEMES
Farmers	Inputs supplier credits – In this arrangement, farms get access to inputs (seeds and feed) on credit, which they repay after harvest. This practice is already in use by some of the feed suppliers; however, some farmers find it hard to pay back the credit, resulting in the lender confiscating the farmer's property. The Activity could de-risk suppliers' exposure to that bad debt through additional financing, especially for credit sales of inputs to a selected category of farms in need. This model can be started with suppliers that are already providing credit sales, and if it is proven successful, it can be replicated with more suppliers. Buyer/processor credits – In this arrangement, a processor or another downstream buyer finances farmers or local traders with advance cash to be used for working capital during the production process. The buyer then sets the prices of its purchases. The farmer or trader gets access to credit, supplies, or secured sales, similar to contract farming. The Activity could facilitate such relationships by encouraging processors or buyers to adopt contract farming models; provide financial support in establishing, operating, and sustaining the model; providing technical and advisory assistance on making the model a success; and helping them find end-market buyers, particularly in export markets. Leasing – This arrangement is used to finance machinery, vehicles, and equipment in both agriculture and aquaculture. The lessee (farmer) usually makes a down payment and can use the asset while making periodic payments. At the end of the term, the lessee may have an option to purchase the asset. This arrangement helps farmers access the machinery, vehicles, and equipment needed to improve farm operations and production. For example, small and micro farms in Inle Region have very limited access to pond preparation machineries and equipment. While they are available for rent from a handful of players, the majority of micro and small farms have limited financial means. DoF leases machinery and equipment free of charge in Inle Region, but demand outstrips supply.

ACTOR	FINACING SCHEMES
Input Suppliers	Input supplier credits is an appropriate tool for input sales to customers, provided that effective guarantees schemes are in place in which a guarantor shoulders the default risk. While establishing such guarantee schemes might be difficult in Myanmar, matching input suppliers with financiers who would bring in additional capital and take on the risk might reduce the burden on the input suppliers and allow them to expand their reach. For example, in Vietnam, credit for feed is financed collectively – 50 percent financed by banks at monthly interest rates of 1 percent to 1.5 percent, 25 percent by the feed supplier, and the remainder by farms. Although feed has to be paid in cash in the beginning, if the input supplier starts to show good production potential over time through farm records, feed becomes available on credit in the remaining months of the season. The Activity could support the development of such schemes in Myanmar by supporting aquaculture sectorial associations and industry players, i.e., farms and feed suppliers, to initiate dialogues with financiers, banks, and microfinance institutions in order to structure the scheme. Potential types of support could be providing expert advice to learning from feed financing models in Vietnam and other countries on how the scheme should be structured, how it should be rolled out, and which regions and types of farms should be prioritized for it. In doing this, the Activity could consider teaming up with players like WorldFish and GIZ, whose expertise and presence on the ground could be leveraged.
Processors and Exporters	Processors believe that low-interest non-collateralized loans are ideal for their financing needs since the amount of loans required by processors could only be provided by banks. However, high interest rates and collateral requirement continue to be a major hurdle. Designating special interest rates for aquaculture businesses would be a feasible solution and will be welcomed by processors. This initiative could be complemented by the development of a dedicated aquaculture development fund to offer loans at more accessible interest rates.

7.3. Increase Compliance with Market Requirements

Market access and trade could be enhanced by increasing producers' compliance with market requirements and then linking them with potential buyers. The Activity could support increased private-sector awareness of key voluntary standards, and help aquaculture companies build their capacity to comply with these standards and other market requirements. General public and private-sector awareness of global trends, buyer requirements, and market entry regulations needs to be enhanced through regular public-private sector consultations headed by DoF and sectorial associations such as MFF and MFPPEA, with support of development partners.

In the textile sector, Turquoise Mountain enhances small-scale textile producers' market access by training them to ensure products meet desired quality standards while also liaising with international end-buyers to identify new markets for producers. A similar model could be adopted in the aquaculture sector through collaboration with big producers and processors such as Shwe Yamone and Asia Thar. To comply with international market standards, private-sector players may need to improve packaging, labeling, and marketing, as well as implement traceability systems, and upgrade or expand their facilities. The Activity can link them to financial service providers to obtain the required financing.

7.4. Support Linkages with Buyers

In addition to responding to market requirements, many aquaculture exporters would benefit from marketing support and help in identifying and making introductions to prospective buyers. The Activity could support Myanmar aquaculture companies' participation in trade fairs and arranging business-to-business meetings. Through grants, the Activity could facilitate Myanmar aquaculture companies' participation in seafood shows such as SEAFEX in Dubai, Seafood Expo Global in Brussels, Seafood Expo North America in Boston, Seafood Expo Asia in Hong Kong, Japan Seafood Show in Tokyo, China Fisheries and Seafood Expo, which would open new market opportunities for local processors and exporters. That said, participation in trade shows is costly and only accessible to a handful of sector

players. GIZ and MFF have supported processors and exporters to participate in such shows through cost-sharing schemes. However, prior to trade show participation, it would be important to provide businesses with the necessary advisory and technical assistance to enhance their capabilities, product development, and quality in order to be able to meet buyer requirements.

7.5. Support Establishment of De-Risking Mechanisms

De-risking mechanisms could enhance aquaculture SME investment attractiveness by mitigating some of the risks of investing directly in SMEs. Mechanisms such as a first loss facility could potentially encourage the establishment of an aquaculture-focused investment fund.

Other de-risking mechanisms could include subsidized credit, guarantees, insurance, value chain financing and other hybrid capital financing instruments, trade financing, internal value chain financing, and long-term loans at favorable interest rates. These should be developed for all types of businesses along the aquaculture value chain. The Activity could support MFF and other sectorial associations representing various aquaculture sub-sectors to initiate dialogue with the Myanmar Banks Association and private banks on developing financial products appropriately structured to meet the needs of the sector and bridge financing gaps for sector businesses. The Activity could also facilitate access to international banking experts on how to best establish and operate such a fund and financial solutions.

The Activity's role in de-risking mechanisms is to provide technical advice and to facilitate the mechanisms' development in collaboration with private sector players such as Myanmar Banks Association, Myanmar Private Equity and Venture Capital Association, and Myanmar Microfinance Association, as well as provide technical advisory services to regulators such as Central Bank of Myanmar and the Financial Regulatory Department of the Ministry of Planning and Finance to develop financial de-risking mechanisms specifically to suit the needs of the aquaculture sector.

7.6. Support Private Sector Advocacy

Myanmar's aquaculture sector's current regulatory framework affects sector growth and could be improved. For example, improvements are needed in land-ownership and land-use policies, better enforcement and implementation of the National Aquaculture Development Plan, establishment of testing facilities and updating existing laboratories for disease management and testing, development of aquaculture zones, and strengthening of research and development programs. The Activity could support sectorial associations such as MFF, MSA, MCEA, and MFPPEA in their advocacy plans through advisory and technical assistance so that they are well-equipped to work with the Government and advocate for the necessary improvements. This can include providing experts and supporting studies and policy analyses to help associations develop evidence-based policy proposals and draft advocacy plans.

7.7. Improve Access to Technologies

Companies operating in the aquaculture sector need productivity-enhancing technologies to scale their operations. For example, farms need proper mechanization to help with pond construction and preparation. The Activity could consider partnering with financiers such as microfinance institutions to facilitate development of a dedicated fund for mechanizing micro and small-scale farms through loans. Rent-to-own models or leasing programs can also be facilitated in partnership with interested machinery and equipment suppliers.

There are opportunities to enhance productivity via technological upgrades in small scale on-farm processing such as the production of dried fish and shrimp, which would also make farmers less vulnerable at times when prices for fresh fish are low. This also offers opportunities for employment of women. For example, U Nanda Shwe, an integrated farmer in Nyaung Tone of Ayeyarwaddy Region, is exploring the option of installing solar dryers in its processing facility for drying fish. Currently, processing facilities use coal as fuel for drying fish even though it affects the quality of the final product. Facilitating access to finance for the installation of solar dryers would be an effective solution. Farms also lack a steady supply of water throughout the year as irrigated water supply prioritizes agricultural farms. Increasing access to solar water pumps in collaboration with Proximity Designs can increase access to alternate sources of water supply.

Hatcheries need external support to access advanced farming techniques, practices, and solutions, as well as upgraded facilities and technologies such as modern temperature control systems. For many hatcheries, access to sufficient broodstock is a major challenge. They require financial support to import sufficient broodstock from countries like Thailand, as well as to implement the necessary upgrades to their facilities, such as improved water treatment systems or new breeder tanks. Hatcheries also need knowledge and skills in broodstock management and the proper ways to hatch the imported broodstock on a commercial scale. The Activity could facilitate access to financing in collaboration with microfinance institutions (for small and medium-sized hatcheries) and banks such as Global Treasure Bank that focuses heavily on the livestock and fisheries sector (for large-scale hatcheries), as well as provide linkages to international hatchery experts for high-growth potential farms that already have secured markets, experience, and adequate infrastructure. The Activity could facilitate access to experienced technicians, as well as dedicated grants or financing schemes.

7.8. Increase Economic Opportunities in Non-Urban Areas

Contract farming can be promoted, especially in the non-urban areas, through effective clustering of aquaculture farmers in the regions. With a strong contract farming system in place, farmers will have better access to inputs, technology, resources, and most importantly, guaranteed markets, which is their main challenge. Contract farming can be developed either by processors and/or exporters, as well as off-takers like City Mart and Metro who have placed increased focus on supply consistency, quality assurance, and food security of the produce they sell. City Mart, for example, has already started contract farming initiatives in vegetable production in Shan State. The Activity could facilitate the establishment of such schemes and relationships, as well as provide the necessary technical advisory support.

Another way to promote aquaculture in non-urban areas is through the promotion of poly-culture, either in the form of different species of fish or rice-fish farming, which is also known as integrated farming. This is an effective way to efficiently intensify fish culture. Climate-change adaptable small indigenous species should be particularly promoted as they are of high nutrient quality and grow in wild. While they are primarily targeted for household consumption, the surplus can be sold in local markets. Realizing the need for poly-culture and preservation of small indigenous species, WorldFish has initiated a LIFT-funded program with the support of DoF, GRET microfinance, and Pact Myanmar.[26] The program promotes the sustainable growth of aquaculture in Myanmar by introducing low-cost small-scale

26 WorldFish Myanmar. https://www.worldfishcenter.org/Myanmar/projects

aquaculture technologies that incorporate small indigenous fish species, mainly with carps and tilapia. The project covered 18 townships in the Ayeyarwaddy Delta and the Central Dry Zone through interventions such as capacity building, establishing new facilities, and dissemination of knowledge and technologies. Similar initiatives could be implemented in other regions.

7.9. Support Innovation and Product Development

Throughout the value chain, there are various companies interested in pursuing value addition and diversification of products and markets. With technical and financial assistance, these companies can diversify product lines to include new species beyond the mainstream Rohu, which on average takes about 18 months to reach market size, to other short-culture period species, such as Tilapia, which only takes 4 to 6 months to reach market size. The Activity could facilitate access to finance for such farms to purchase imported Tilapia seeds by working with financial institutions such as banks and microfinance institutions to support development of more suitable financial products and loan schemes that are more accessible to farmers and have lower interest rates or simplified eligibility criteria. Support in accessing such financing schemes could be complemented by trainings and advisory support on the handling of new species and farming techniques as well as assistance in finding buyers. Similar technical and financial support to access new technologies, equipment, or tools, coupled with required technical assistance and advisory support, could be provided to hatcheries that are looking to diversify into other fish species by importing broodstock or to firms looking to expand markets and products into higher value-added products, such as fillet, snacks, collagen, etc. The Activity could work with sector associations or organize challenge fund competitions to identify such innovators.

7.10. Improve SME Management and Production Practices

Enhancing the use of technology, such as mobile applications, could result in enhanced market access, improved farm operations, increased productivity, and enhanced product quality. For example, producers targeting the domestic market require real-time market information to keep up-to-date with changes in the market. Farmers currently lack access to market and price information and are unable to make informed decisions on production planning, which in turn can lead to overproduction and a drop in market prices. Greenovator's mobile app provides information on daily market prices and matches producers with potential buyers and processors/exporters. However, the rate of adoption and reach of the app are still limited. The Activity could consider collaborating with Greenovator to expand its reach and support its commercial sustainability by taking commissions on commercial transactions, advertisements, and online consultations with experts. The app could expand its features to include farm advisory services, matching farmers with buyers, guidelines on GAqP certification and other market requirements, financial literacy, generation of basic financial records, and links to experts.

Farms lack proper farm management knowledge and tools. Many farms are relatively large and have ponds of 20 to 30 acres. Myanmar follows an extensive culture system where fish are raised in high density in large ponds, primarily because managing small-scale ponds requires more expertise. Advocacy for small ponds usage (a better practice for effective pond management in Vietnam and Thailand that is well suited for Myanmar) as well as supporting farms with hands-on trainings on proper farm management could improve farms' productivity as well as compliance with market requirements. The Activity could collaborate with sectorial associations, such as MFF and MSA, as well as with ecosystem players like WorldFish and MYSAP, to promote the adoption of improved farm management

technologies. Farm investment readiness should also be enhanced through improved business planning and financial record keeping systems.

7.11. Assist in Establishing Traceability Systems

Traceability in aquaculture supply chain aims to ensure the safety and quality of the produce. Although traceability implementation is not mandatory in Myanmar, it is vital for penetration into higher value markets such as the United States and EU. In Myanmar, the concept of traceability is still relatively new, but companies like Yuzana are working toward implementing it in their production systems. According to MSA, if Myanmar exports can provide assurance on traceability and food safety, exports will be able to command a premium price of 50 percent more than current prices.

Many ASEAN member countries have implemented electronic and computerized traceability systems to meet the growing demand for traceability from international buyers, but implementing such systems in Myanmar is challenging since farms often lack proper recordkeeping. Instead of introducing traceability systems at the farm level, it is recommended to work first with the downstream players, processors/exporters like Yuzana or Shwe Yamone, to support them in implementing such systems with their suppliers. Since these players are already producing at scale, targeting high-value export markets, and have adequate resources, they are best placed to drive such a change in the market. The Activity could support these processors/exporters by facilitating access to already-available traceability software or supporting the development of new software via grants. Mobile apps such as Greenovator and Shwe Ngar already have the functionality of daily log-ins of farm activities and inputs usage and could be potentially upgraded to include a traceability component.

Implementing such traceability models has been successful in other sectors in Myanmar. For example, in the rubber industry, some premium buyers have already committed to buying only sustainable and high-quality rubber with full traceability. DGL became the country's first sustainable rubber producer providing traceability assurance with assistance from a DFID grant and technical support from WWF. DGL directly buys latex from smallholders at collection points and keys in the data on the spot in order to ensure that traceability, community engagement, and sustainability standards are met. After having established this traceability system, DGL was able to sign contracts with major premium end-market buyers.

8.2. Appendix B: Bibliography

National Export Strategy, Fisheries Sector Strategy, NES 2020-2025

National Aquaculture Development Plan (NADP) 2020, Department of Fisheries

https://www.mdn.gov.mm/en/fishery-exports-soar-over-847-mln-2019-2020fy

Department of Fisheries Statistics. Ministry of Agriculture, Livestock and Irrigation. http://www.dof.gov.mm/index.php/fishery-statistics

Green Facts. http://about.greenfacts.org/index.htm

World Bank and FAO. "Fish to 2030: Prospects for Fisheries and Aquaculture." FAO. December 2013. http://www.fao.org/3/i3640e/i3640e.pdf

OECD-FAO. "Agricultural Outlook 2020 – 2029." OECD-FAO. https://www.oecd-ilibrary.org/agriculture-and-food/oecd-fao-agricultural-outlook-2020-2029_1112c23b-en

The Fish Site. "Ecuador Says that Shrimp Exports to China Are Back on Track after COVID-19 Dispute." August 12, 2020. https://thefishsite.com/articles/ecuador-says-that-shrimp-exports-to-china-are-back-on-track-after-covid-19-dispute

Ferdouse, Fatima, Susan Løvstad Holdt, Rohan Smith, Pedro Murúa, and Zhengyong Yang. "The global status of seaweed production, trade and utilization." FAO. 2018. http://www.fao.org/3/CA1121EN/ca1121en.pdf

Food and Agriculture Organization. "World Food and Agriculture - Statistical Yearbook 2020." FAO. https://doi.org/10.4060/cb1329en

Food and Agriculture Organization. "The Global Status of Seaweed Production, Trade and Utilization." FAO. 2018. http://www.fao.org/in-action/globefish/publications/details-publication/en/c/1154074/

Thiha Ko Ko. "Myanmar Launches Aquaculture Roadmap." *Myanmar Times*. March 17, 2020. https://www.mmtimes.com/news/myanmar-launches-aquaculture-roadmap.html

Barbalho Hungria, Diogo. "Global Status of Production and Commercialization of Soft-Shell Crabs." Springer International Publishing. July 2017. https://gia.org.br/portal/wp-content/uploads/2017/11/10.1007_s10499-017-0183-5.pdf

WorldFish Myanmar. https://www.worldfishcenter.org/country-pages/myanmar

Kumar, Sumesh, and Roshan Deshmukh. "Aquaculture Market by Environment and Fish Type: Global Opportunity Analysis and Industry Forecast, 2021-2027." Allied Market Research. November 2020. https://www.alliedmarketresearch.com/aquaculture-market

Aregu, Lemlem and Surendran Rajaratnam. "Towards a Gender-Equal Fisheries Sector in Myanmar." WorldFish Center. July 3, 2017. http://blog.worldfishcenter.org/2017/07/toward-a-gender-equal-fisheries-sector-in-myanmar/