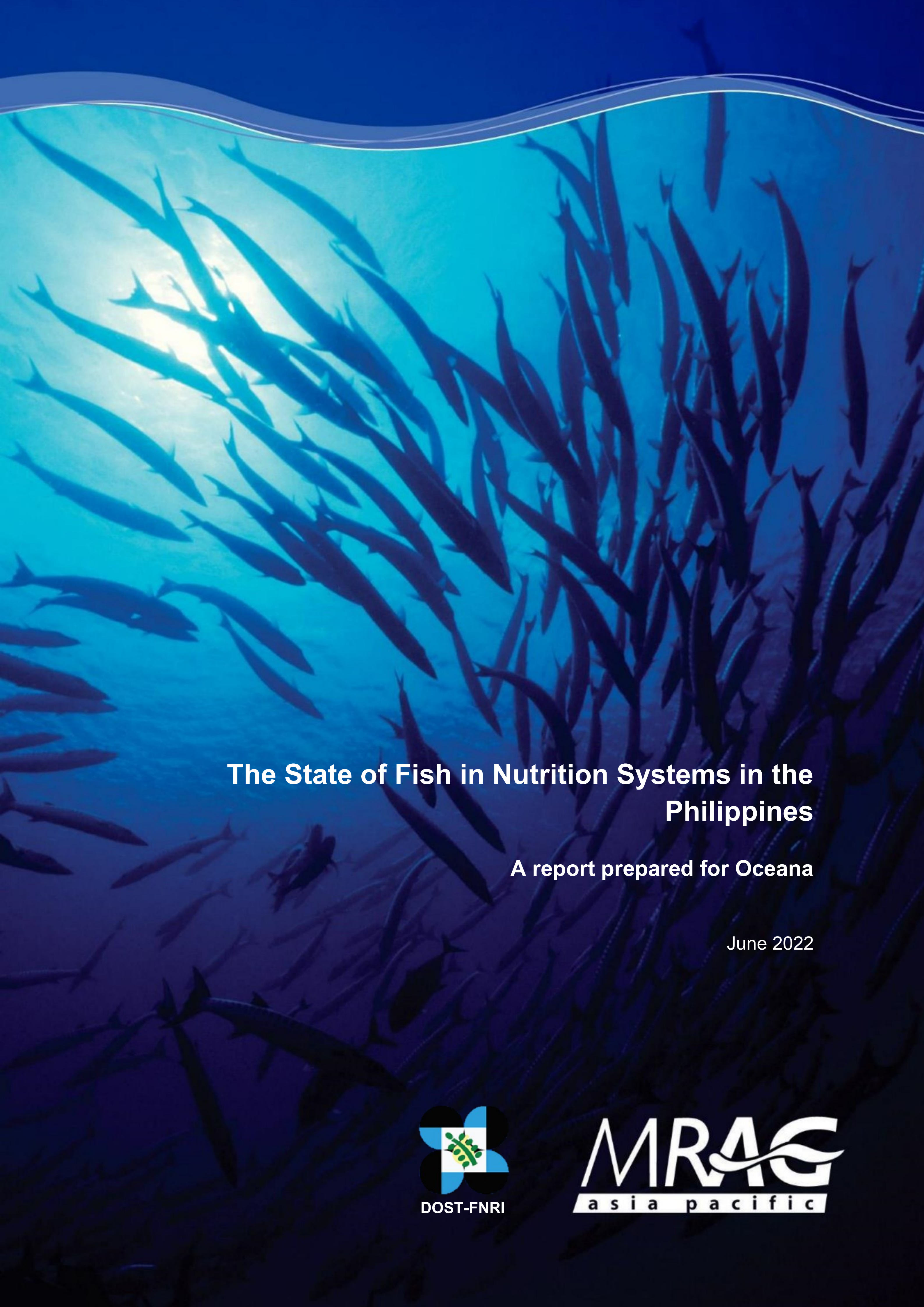

The State of Fish in Nutrition Systems in the Philippines

A report prepared for Oceana

June 2022

DOST-FNRI

MRAG asia pacific

About MRAG Asia Pacific

MRAG Asia Pacific is an independent fisheries and aquatic resource consulting company dedicated to the sustainable use of natural resources through sound, integrated management practices and policies. We are part of the global MRAG group with sister companies in Europe, North America and the Asia Pacific.

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Executive Summary

BACKGROUND AND APPROACH

The Philippines has long been ranked among the top fish producing countries in the world, with fisheries a strategically important sector for both food security and livelihoods. However, the livelihood and food security related benefits of Philippine fisheries have been dissipating through time due to the overexploitation of marine resources and declines in aquaculture production.

Recognising that seafood is an excellent source of energy, protein, and vital nutrients for human health, this study was commissioned by Oceana to 1) determine the role of Philippine fisheries in terms of food security and livelihoods (income and employment), both at a national and regional scale; 2) assess future risks to food security and livelihoods in the Philippines; and 3) provide advice to Oceana on policy options to strengthen the contribution of fish in nutrition systems in the face of ecosystem change.

To achieve this, we first provide a brief socio-economic profile of the Philippines and then assess the role of the Philippine commercial, municipal (marine and inland), and aquaculture sectors in terms of their contribution to livelihoods and food security at both a national and regional level. By consolidating available information from national government reports and datasets, studies from the peer-reviewed literature, grey-literature reports, and importantly, data collected by the Philippine Department of Science and Technology - Food and Nutrition Research Institute (DOST-FNRI) from 163,235 individuals (41,204 households) distributed throughout the Philippines in 2018-19, we ensured the best available data was used to generate contribution estimates of each sector and target/ culture species to food security and livelihoods. Caveats and inconsistencies among these data sources are discussed throughout the report and knowledge gaps in our understanding of the role of fish in nutrition systems in the Philippines were identified as opportunities for future research. Key threats to fish in nutrition systems and policy advice to ensure the continued contribution of Philippine fisheries to livelihoods and food security became clear during the consolidation of data leading to estimates of sector and species contributions to livelihoods and food security. These are reported and discussed within our report in order of perceived priority.

ESTIMATED CONTRIBUTION OF PHILIPPINE FISHERIES TO LIVELIHOODS AND FOOD SECURITY

Employment in Philippine fisheries

Fishing and aquaculture are major industries in the Philippines, providing direct employment to around 1.35-1.41 million workers and indirectly employing around 537,872 individuals engaged in fish-related activities. Nevertheless, we note there is significant uncertainty surrounding these estimates which stems from data collection issues, discrepancies among various government departments, and a general lack of disaggregated estimates according to target/ culture species and location.

The available data indicated that most fishers are engaged in the marine municipal sector, using boats within the Bicol, Eastern Visayas, and MIMAROPA regions. Municipal fishers obtained significant value from the catch of scombrids (tunas and mackerels) and carangids (jacks and scads) at both a national and regional level. Accordingly, these taxonomic groups appear important in terms of supporting municipal fisher employment. Nevertheless, it is important to understand that municipal catches are generalist in nature, often comprising both demersal and pelagic species. Consistent with this, we also show that several demersal species play important roles in supporting municipal fisher incomes.

The commercial sector likely provided the second greatest contribution in terms of fisher and fish worker employment, primarily through the commercial tuna and sardine industries. Aquaculture was ranked 3rd in terms of employment, but data on employee numbers were often contradictory and no recent disaggregated data on employment by culture environment or species were available. Inland municipal fisheries employed the least number of people of all the fishery sectors.

Economic contribution of Philippine fisheries

The contribution of fisheries to the Philippine economy was assessed at two levels: (i) the contribution of fisheries sectors and target species to the national economy examined through the gross value of production, at both a national and regional level, and (ii) the economic contribution of fisheries sectors and target species to individual fisher incomes.

i) Gross value of production

In 2020, the Philippines reported 4.4 million tonnes of total seafood production across sectors, valued at approximately 273 billion PhP or US$5.2 billion. Between 2018 and 2020 wild capture fisheries cumulatively accounted for around 58% of gross production value, with the commercial sector contributing 23% and the municipal sector (marine and inland) accounting for 35% of total annual production value. The aquaculture sector contributed 42% of gross production value on average over the same period. Like data on fisheries employment, these data are subject to several discrepancies and caveats.

The ten most valuable species/ species groups in terms of production value at a national level were milkfish, tilapia, the “others” species group, tiger prawn, skipjack tuna, round scad, yellowfin tuna, seaweeds, mud crab, and frigate tuna. Sector specific contributions to the gross value obtained from the landings of these taxonomic groups is discussed within the report and, in doing so, we consider methods of catch utilization, trends in economic trade, and evidence of stock depletion that may impact the present and future economic contribution of these key fisheries targets. An analysis of the most valuable species landed/ cultured by each fishery sector according to the gross value of production among the 17 administrative regions of the Philippines is also provided.

ii) Per employee income

We note that generally there were few available estimates of fisher and fish worker incomes. Nevertheless, to determine the likely gross per employee income of fishers and major actors involved in the typical value chain of each fisheries sector we conducted a substantial search of the literature (i.e., government reports, peer-reviewed publications, grey-literature reports) published within the past 10 years (2012 – 2022).

From these data, it was evident that municipal fishers earnt a higher gross average daily income than fishers in the commercial fishing industry, although we note that municipal fisher incomes were highly variable among regions/ studies, and that the mean gross daily income still amounted to less than 500 PhP or US$10 per day. This is barely enough for municipal fishers to cover daily expenses and support their households which generally comprise 3.3 (± 1.5) dependents (Anticamara & Go, 2016; Muallil et al., 2014; Samonte et al., 2016). It was difficult to provide discussion surrounding net income due to the variety of fishing activities and operational arrangements in the municipal sector. There were also few data on the incomes of those downstream of municipal fishers (e.g., local vendors). Nevertheless, data on the incomes of major actors downstream of the commercial fishing industry indicated mean daily incomes of around US$10, with high variation between roles performed.

The contribution of fisheries to domestic seafood consumption

Estimates of seafood consumption in the Philippines have long been in decline. In 1993, the per capita rate of seafood consumption was estimated at 36 kg/ year and in 2018-19 data from the DOST-FNRI Expanded National Nutrition Survey (ENNS) indicated that the average annual edible portion weight of seafood consumed per individual is now equivalent to 14.32 kg[1]. Fresh fish is the most common type of seafood consumed, with processed fish, crustaceans and molluscs accounting for lesser proportions of seafood consumption.

The consumption of fresh fish among urban and rural consumers did not differ greatly at the national level, but rural consumers ate significantly greater amounts of canned fish, dried fish, fish paste, and various “Other” fish and crustacean species (defined in annex 3). A stronger trend was evident among wealth levels, with the quantity of fresh fish consumed increasing with increasing levels of wealth. Conversely the amount of processed fish consumed at the household level generally declined as wealth increased, while the consumption of crustaceans and molluscs only increased in the richest households, with relatively similar consumed weights evident among the poorest, poor, middle, and rich households.

The most consumed taxa at a national level in 2018-19 were tilapia, round scad, and milkfish, collectively accounting for ≈39% of the total weight of seafood consumed per individual on average. Subsequent commonly consumed categories were “Other fresh fish and cooked fish recipes” (comprising miscellaneous species defined in annex 3), frigate tuna, canned fish (e.g., tuna, sardines, mackerel etc.), and big-eyed scad.

At a regional level, individuals in the Cordillera Administrative Region (CAR) and the National Capital Region (NCR) consumed the least fresh fish per day, while those in Zamboanga Peninsula (Region IX) consumed the greatest amount of fresh fish per day. In fact, at a regional level there appeared to be a general decline in the proportion of fresh fish consumed as latitude increases, with those located in southern areas of the country consuming more fresh fish on average than those in northern regions. This spatial trend in fish consumption does not correlate with the distribution of fishers or the population and requires further investigation.

Across regions of the Philippines, greater consumption of wild-caught species, round scad and frigate tuna, correlated with greater amounts of protein, iron, calcium, and vitamin A being obtained from fresh fish. Such results emphasise the importance of considering the nutritional composition of consumed fish species, rather than just the weight of consumption, when designing policies and programs aimed at improving food and nutrition security.

[1] While we acknowledge that the 1993 estimate was ‘per capita’ and the 2018-19 estimate was ‘per individual’, this nonetheless represents a substantial decline in seafood consumption over the past 25 years.

ANALYSIS AND MAIN MESSAGES

Apart from the headline contribution estimates, there are several key messages arising from the analysis:

- **Tilapia and milkfish are commonly consumed at the national level, but their contribution to food security should be seen in context** - At the national level, aquaculture produced milkfish and tilapia were ranked 1st and 3rd most consumed species in 2018-19, collectively comprising ≈26% of total seafood consumption per individual. Nevertheless, milkfish and tilapia offer fewer nutrients per serve compared to the diverse suite of pelagic species landed by wild capture fisheries. The aquaculture sector also employs far fewer people than wild capture fisheries, is capital intensive, and often environmentally destructive. While landings from wild capture fisheries are generally consumed in lower taxa-specific volumes, it is evident that wild-capture fisheries (commercial and municipal sectors) are the primary contributors to food security, with the marine municipal sector contributing more to livelihoods (employment, income) than the commercial sector. The livelihood and food security related benefits of wild capture fisheries should also be framed with the perspective that Philippine fish stocks are currently of poor health. Accordingly, effective management that increases stock health would almost certainly boost the already substantial benefit of wild-capture fisheries to fisher livelihoods and food security.
- **Food security can only be achieved at a national level by providing food to those most food insecure** – given that the incidence of food insecurity is greater in remote regions and among those on low incomes, two underestimated and likely underappreciated resources are 1) coral-reef fishes caught by municipal fishers, particularly in remote locations, and 2) invertebrates gleaned from the intertidal zone. It is evident that municipal landings are almost certainly underestimated and the contribution of reef fishes to food security in remote locations remains largely unquantified. With regards to gleaners, data on catch at a regional and national level is severely lacking (Palomares & Pauly, 2014) but the benefits are clear at the local level; gleaning provides high-quality seafood for subsistence, offers alternative or extra income, can be performed with very little to no capital, is often the easiest food provision option of poor coastal families, and is carried out mostly by women (and to some extent by men and children) in contrast to Philippine capture fisheries which are generally male dominated (De Guzman et al., 2016, 2019).
- **Philippine coral reefs have been historically undervalued for their contribution to food security and livelihoods** - The 15 km band of coastline dotted with coral reefs and accessible to municipal fishers currently supports 50 times more employment than the remainder of the EEZ fished by the commercial sector, notwithstanding the significant but undocumented downstream employment of the municipal fishing sector (i.e., local landing sites, markets, etc.). Moreover, despite the overexploited nature of most stocks, demersal fishes remain an important component of municipal catches, comprising around 54% of municipal catch composition (Muallil et al., 2014). Coral reef ecosystems of the Philippines also support various life-stages of reef-associated pelagic species which are important for fisher livelihoods (both municipal and commercial) and food security, such as round scad and big-eyed scad. Coral reefs therefore offer several direct benefits in terms of livelihoods and food security. However, when compared to the substantial government assistance and foreign aid historically

directed towards the development of aquaculture and the pursuit of valuable foreign export markets supplied by a highly efficient commercial fleet, the management of coral reefs in the Philippines has been proportionately inadequate and mostly NGO-driven. There remains a need to refocus government support on coral reef ecosystems which ensure reliable fish production and secure livelihoods for the majority of stakeholders, municipal fishers.

KEY THREATS TO FISH IN NUTRITION SYSTEMS IN THE PHILIPPINES

1) Ineffective fisheries management

Fisheries management to date has been ineffective at reducing overcapacity, rebuilding overexploited fish stocks, and improving the income, employment, and food security of Filipinos. Consequently, the future of fish in nutrition systems will depend heavily on the will of management agencies and the political system to implement effective management measures and their ability to educate coastal communities on the importance and benefits of resource stewardship. In the Philippine context, in addition to political will, the main impediments to stronger fisheries management are limitations on capacity, both financial and human. Given the poor state of fish stocks across the country there is a clear need for the management of fisheries at scales above the community level. However, given the lack of biological understanding surrounding targeted stocks, their habitats, and spatial patterns of fishing effort, the scale of effective management remains unclear. While data for the commercial sector will be improved substantially when newly implemented VMS requirements are implemented in full, catch and effort data currently collected for the larger municipal sector are unreliable and insufficient to assess stock status or determine effective management reference points. As such, there remains a need to improve the data collected for the municipal sector, particularly for species deemed important for nutrition by the present study. Funding options to support improved data collection, including through improved cost recovery in the commercial sector, are explored.

2) Overcommitment of commercial landings to foreign export markets

In 2019, the Philippines fishing industry exported 264,254t of seafood worth 1,125 million US dollars (DA-BFAR, 2020a). While these exports earned valuable export revenue, they largely comprised fish important for nutrition and food security, specifically tuna and in lesser proportions round scad, bigeye scad, and sardines. Given the obligation in the Philippines Fisheries Code of 1998 that exports are to be managed to not negatively impact domestic food production, the Philippines has important policy decisions to make around the proportion of nutritionally important species it allows to be exported versus retaining in country to support domestic consumption.

3) Concomitant impacts of climate change

The impacts of climate change are becoming increasingly important in driving ecosystems and fish stocks globally. The Philippines is not immune to such changes, with climate change predicted to exacerbate the plight of the poor, due to their lower capacity to adapt to potential risks (World Bank, 2018). This is particularly true for poor households in the north of the country which derive most of their income from fishing, as the number of fishing days will almost certainly be limited by increased frequency of disturbance events (e.g., typhoons), with flow-on effects to fishers and fish consumption among these communities (Holden & Marshall, 2018). Given the increasing risk posed by climate change, the development of effective fisheries management, particularly for stocks deemed important for consumption, in the country is paramount.

CONCLUSION

This study provides the first detailed assessment of the importance of the various fishery sectors and target species for food security in the Philippines. We also consolidate information from the existing literature on the role of the various fishing sectors in supporting the livelihoods of fishers and downstream workers. We hope that this data focuses efforts of the national government, LGUs, and NGOs on the sectors, regions, species, and stocks deemed most important for food security and nutrition. While it is evident that the role of fish in nutrition systems of the Philippines has declined through time and many challenges lay ahead, if managed strategically, food and nutrition-based policies and landings from Philippine fisheries could sustainably enhance the diet quality of millions of people and strengthen food security among the population, particularly in locations where people have access to fish but inadequate nutrient intakes.

1 Background and Purpose of the Study

The Philippines is one of the top producers of wild-caught fish in the world, ranking 8th among marine capture fish producing countries in 2018 (DA-BFAR, 2020a; FAO, 2020). Its total production of 4.354 million tonnes accounted for 2% of the total world's total production (211.87 million metric tons; DA-BFAR, 2020a; FAO, 2020). The Philippines is also a dominant player in aquaculture, ranking 11th in the world in terms of the volume of cultured fish produced in 2018 (FAO, 2020). While fisheries are not of primary importance to the national economy, in 2019 the Philippine fisheries sectors contributed 228 billion PhP (≈US$4.34 billion[2]), or 1.2% percent to the country's Gross Domestic Product (GDP) at current prices (DA-BFAR, 2020a). Of greater importance is the contribution of Philippine fisheries to employment and food security for the predominantly coastal population. Capture fisheries and aquaculture currently support around 1.95 million jobs (DA-BFAR, 2020a) and Filipinos are highly dependent on the consumption of seafood, which comprises 42.2% of total animal protein intake on average (DOST-FNRI, 2020).

However, the livelihood and food security related benefits of Philippine fisheries are dissipating through time due to the overexploitation of marine resources.

Fish stocks have declined to <10% of 1950s levels in major fishing grounds of the Philippines and continue to be overexploited in many areas (Alcala & Russ, 2002; Green et al., 2003; Lavides et al., 2016; Muallil et al., 2014, 2019). As a result, gross landings from marine capture fisheries have been declining since at least 2010[3] at a rate which is predicted to lead to collapse if fishing exploitation is not reduced by effective management (Newton et al., 2007). Most worrisome is that the catch and income of municipal fishers, who depend most on fish for nutrition and livelihoods, continue to decline, resulting in concomitant impacts on at least 10 million Filipinos who rely directly on small-scale fishing to meet their household food needs (Lavides et al., 2016; Muallil et al., 2014; DA-BFAR, 2010). Indeed, fishers have long been one of the poorest and most food insecure sectors of the economy, with official poverty statistics released in 2018 revealing that the fisheries sector had a poverty incidence of 26.2%, which is considerably higher than the national average of 16.6%[4].

The cumulative pressures of unsustainable development, a burgeoning population (and number of fishers), and an increasing frequency of severe disturbance events driven by climate change has also contributed to the declining health of Philippine fish stocks. Mangrove forests have now been reduced to less than a third of the original 40,000ha, <1% of coral reef areas remain in excellent condition (coral cover >75%), and around 2.2 million tons of organic pollutants are released into the country's marine environment annually (Asian Development Bank, 2014; Hishamunda et al., 2014; Licuanan et al., 2019; Nañola et al., 2006). The degradation of habitats has compounded the negative effects of overfishing on targeted stocks and has further reduced the availability of nutritious seafood for Filipino consumption. Estimates of seafood consumption has reduced from 36 kg/ year in 1993 to just 14.32 kg in 2018-19, with the decline in fish consumption even more pronounced in fishing communities that ensure the consumption of fish is possible for urban consumers (Cruz-Trinidad, 2003).

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[2] Using exchange rate at time of writing: US$1 = 52.59PhP

[3] Based on catch reported by the FAO on behalf of the Philippines and Philippines Statistics Authority data.

[4] PSA data

While aquaculture production has increased substantially through time and is often touted as a solution to the gap in fish production caused by an increasing population and overexploited wild fisheries, it must be noted that the expansion of this sector has generated numerous social, environmental, and economic problems in the Philippines. For example, the historical development of prawn aquaculture fuelled by lucrative export markets resulted in the destruction of vast swathes of mangrove resources, caused conflicts over the use of natural resources, and negatively impacted wild capture fisheries and those who depend on them for income, employment, and food security (Dunaway & Macabuac, 2007; World Bank, 1989). Aquaculture also employs far fewer people than wild capture fisheries (DA-BFAR, 2020a) and the productivity of Philippine aquaculture has declined through time on a per hectare basis due to a scale-back in government assistance, water quality problems, and disease (CRMP, 1998; Cruz-Trinidad, 2003; Guerrero, 2019; PSA data). Nevertheless, given the poor health of wild fish stocks and the abundant aquaculture opportunities, environmentally sustainable aquaculture production remains important for achieving food security from fish, particularly in the short- to medium-term.

In the face of ongoing environmental degradation and a burgeoning population, it is evident that significant economic, environmental, and population health reforms will be required to ensure that Filipinos have reliable livelihoods and sources of affordable and nutritious food into the future. Recognising that seafood is an excellent source of energy, protein, essential fatty acids, and vital nutrients for human health, this study was commissioned by Oceana to 1) determine the role of Philippine fisheries in terms of food security and livelihoods (income and employment), both at a national and regional scale; 2) assess future risks to food security and livelihoods in the Philippines; and 3) provide advice to Oceana on policy options to strengthen the contribution of fish in nutrition systems in the face of ecosystem change. This report was produced by MRAG Asia Pacific in collaboration with the Philippine Department of Science and Technology - Food and Nutrition Research Institute (DOST-FNRI) with view to strengthen the evidentiary link between healthy fisheries and healthy communities, as well as helping Oceana target the highest priority areas for future work on fisheries and food security in the Philippines. The Terms of Reference for the study are included in Annex 1.

Broadly, the report is organised into five sections. Following this Background Information section, Section 2 provides a brief socio-economic profile of the Philippines, including information on which groups are most reliant on seafood for nutrition. Section 3 estimates the contribution of each Philippine fishery sector and specific target-species to employment and income, while Section 4 determines the most important fisheries for domestic consumption at both a national and regional level. Section 5 provides a critical analysis of the data contained in sections 2-4 and determines likely risks to the contribution of fish in Philippine food systems.

2 Socioeconomic Profile of the Philippines

The archipelagic nation of the Philippines is the centre of marine biodiversity (Carpenter & Springer, 2005) and is the sixth largest island country in the world, comprising 7,641 islands and an Exclusive Economic Zone (EEZ) that spans 2,200,000 km^2. The Philippine islands are divided into 17 regions, which can be further subdivided into smaller administrative units composed of 81 provinces; 138 cities; 1,488 municipalities; and 42,046 barangays[5] (Figure 1). Approximately 78% of these provinces are coastal and the majority (60-70%) of the 110 million population[6] live in coastal areas (Asian Development Bank, 2014b; Palomares & Pauly, 2014). Over the past decade, the Philippines has experienced significant GDP growth, averaging ≈6.4% annually between 2010 and 2019[7]. Nevertheless, the Philippines has struggled to bridge the disconnect between national economic development and improved livelihoods, secure food systems, and environmental sustainability.

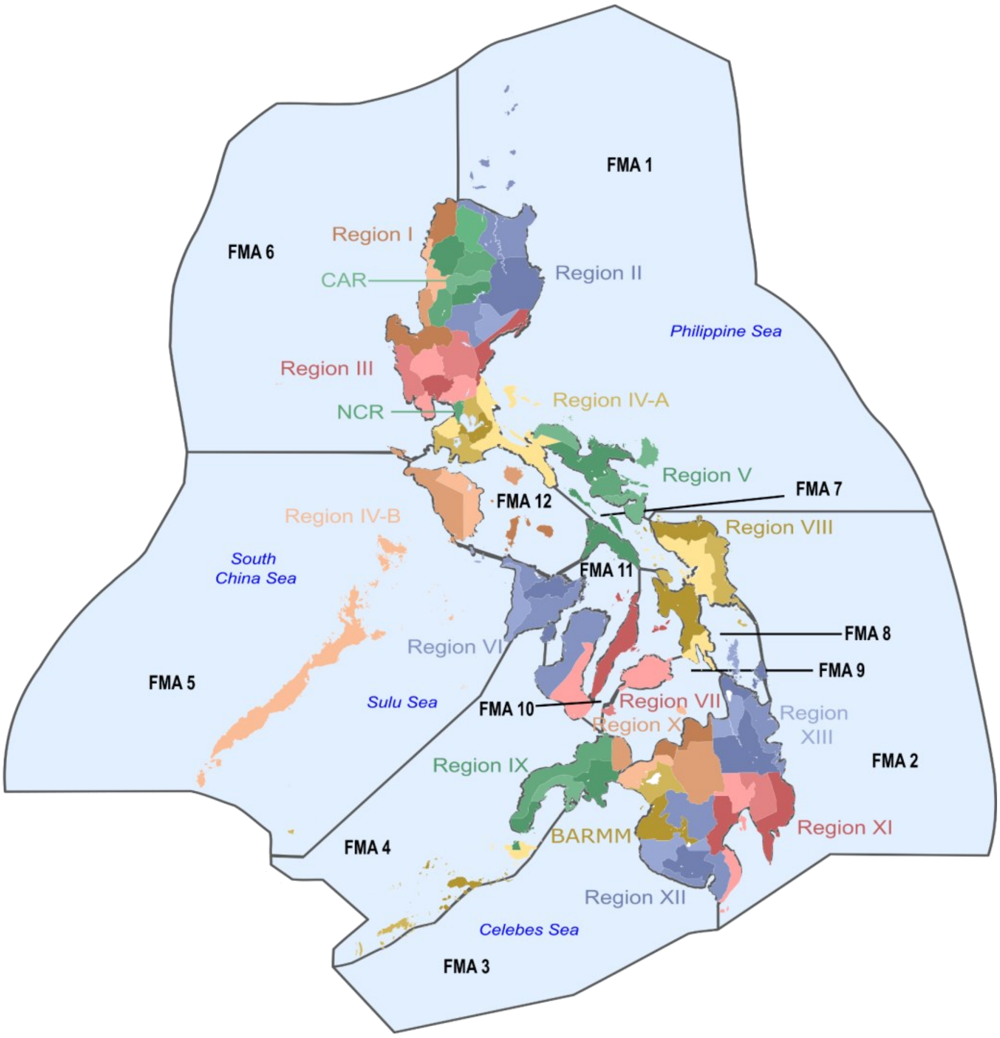

Figure 1: Map of the Philippines showing the locations of the 17 administrative regions and 12 Fishery Management Areas (FMAs). Region I – Ilocos, CAR – Cordillera Administrative Region, Region II – Cagayan Valley, Region III – Central Luzon, NCR – National Capital Region, Region IV-A – Calabarzon, Region IV-B – MIMAROPA, Region V – Bicol, Region VI – Western Visayas, Region VII – Central Visayas, Region VIII – Eastern Visayas, Region IX – Zamboanga Peninsula, Region X – Northern Mindanao, Region XI – Davao, Region XII – SOCCSKSARGEN, Region XIII – Caraga, BARMM – Bangsamoro Autonomous Region in Muslim Mindanao. Blank map file sourced from: HueMan1, via Wikimedia Commons.

[5] PSA: 30 September 2020 *Number of provinces, cities, municipalities and barangays, by region.*
[6] Asian Development Bank Basic Statistics 2021
[7] WorldBank data on GDP growth (annual %)

2.1 Employment and Income

Despite the growth evident in the Philippine GDP over the past decade, wage share of GDP increased just 4.7% over the 2010-2018 period and the rate of unemployment improved just 2.28% across the Philippine population between 2010 and 2019[8]. In 2019, the national unemployment rate was estimated at 5.1%, increasing to 10.3% in 2020 due to the impact of COVID-19, and recovering slightly thereafter to around 7.9% in 2021[9]. Low quality jobs are common in the labour market, with just 62.9% of employees working in paid jobs in 2020, while 28.3% were self-employed with no guaranteed salary or wage, 2.5% were an employer in their family-owned farm or business, and 6.3% worked on family-owned farms for no pay, albeit typically receiving food and lodging[10]. While labour force participation rate is relatively high compared to other Asian countries, a declining trend has been evident since 2014, with labour force participation rate estimated at 59.5% in 2020 (Table 1). With an average annual household income of 313,348 PhP[11] (US$5,958[12]) and an average household size of 4.4 persons[13], per capita income is relatively low.

With that being said, there is significant regional variation in the employment and income levels of Filipinos. In 2020, the Northern Mindanao region (Region X) was best placed in terms of employment and labour force participation rates, albeit having moderate levels of underemployment, while the Ilocos Region (Region I) had the highest rate of unemployment at 13.4% (Table 1). Double digit unemployment rates were also evident in the following regions: Central Luzon (Region III; 13.1%), National Capital Region (NCR; 11.7%), Calabarzon (Region IV-A; 11.6%), Cordillera Administrative Region (CAR; 10.4%), and the Central Visayas (Region VII; 10.3%).

Table 1: Population size and employment rates in 2020 at the national level and for each region of the Philippines.

Region	Population[a]		Labour force participation rate (%)[b]		Employment rate (%)[b]		Unemployment rate (%)[b]		Underemployment rate (%)[b]	
	EST	Share to national total (%)	EST	SE	EST	SE	EST	SE	EST	SE
Philippines	109,035,343	100	59.5	0.1	89.7	0.1	10.3	0.1	16.2	0.2
NCR	13,484,462	12.4	57.5	0.3	88.3	0.3	11.7	0.3	9.2	0.5
CAR	1,797,660	1.6	61.4	0.5	89.6	0.6	10.4	0.6	14.5	0.9
Region I	5,301,139	4.9	62.6	0.6	86.6	0.8	13.4	0.8	17.2	1.1
Region II	3,685,744	3.4	61.3	0.6	91.3	0.5	8.7	0.5	16.8	1.1
Region III	12,422,172	11.4	56.9	0.5	86.9	0.5	13.1	0.5	12.1	0.6
Region IV-A	16,195,042	14.9	61.7	0.4	88.4	0.5	11.6	0.5	17.2	0.8
Region IV-B	3,288,558	3	59.6	0.5	92.7	0.5	7.3	0.5	23.9	1.0
Region V	6,082,165	5.6	59.5	0.5	90.5	0.4	9.5	0.4	27.5	1.0
Region VI	7,954,723	7.3	58.7	0.5	92.2	0.4	7.8	0.4	11.7	0.7
Region VII	8,081,988	7.4	58.7	0.7	89.7	0.7	10.3	0.7	15.8	1.0
Region VIII	4,547,150	4.2	58.2	0.5	92.0	0.4	8.0	0.4	20.1	1.2
Region IX	3,875,576	3.6	56.9	0.6	90.1	0.6	9.9	0.6	17.0	0.9

[8] PSA data
[9] National Economic and Development Authority's *Weekly Economic Update for 2/2/2022:* Unemployment rate based on Jan-Nov 2021.
[10] PSA: 2020 *Annual Preliminary Estimates of Labor Force Survey*
[11] PSA: 2018 *Family Income and Expenditure Survey*
[12] Based on conversion rate at the time of writing: US$1=52.59PhP
[13] PSA: 2015 *Census of Population*

Region X	5,022,768	4.6	66.3	0.5	93.6	0.3	6.4	0.3	23.6	1.1
Region XI	5,243,536	4.8	57.5	0.4	90.8	0.6	9.2	0.6	13.0	0.9
Region XII	4,901,486	4.5	62.9	0.7	90.9	0.7	9.1	0.7	22.2	1.2
Region XIII	2,804,788	2.6	63.5	0.5	92.4	0.4	7.6	0.4	23.0	1.2
BARMM	4,404,288	4	53.5	0.8	91.0	0.8	9.0	0.8	10.1	1.0

EST = estimate, SE = standard error.

a) Source: PSA *2020 Census of Population and Housing*. Note that population counts and shares of each region do not add up to national total, which includes 2,098 Filipinos in Philippine Embassies, consulates, and missions abroad.

b) Source: PSA *2020 Labor Force Survey*.

Households in the National Capital Region (NCR) had the highest average annual income in 2018 of 460,384 PhP or US$8,754 to support an average household size of 4.1 people (Figure 2). Similarly, households in Calabarzon (384,170 PhP or US$7,305), Cordillera Administrative Region (353,921 PhP or US$6,730), and Central Luzon (333,986 PhP or US$6,350) had relatively high levels of income to support 4.2-4.4 individuals per household on average (Figure 2). The lowest average annual family incomes in 2018 were evident in BARMM at 161,107 PhP or US$3,063, a region with 6.1 individuals per household on average, the highest in the country (Figure 2).

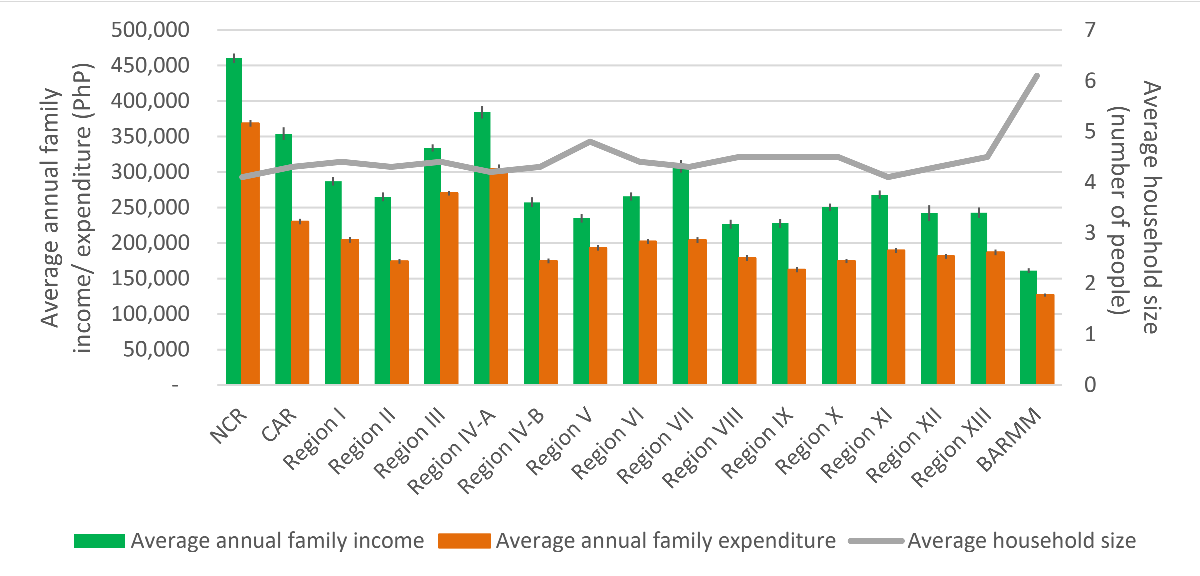

Figure 2: Average family income, expenditure, and number of people per household for each region of the Philippines. Average annual family income and expenditure sourced from PSA 2018 Family Income and Expenditure Survey. Average number of people per household sources from PSA 2015 Census of Population.

2.2 Poverty, Subsistence, and Malnutrition

While the Philippines achieved substantial declines in the incidence of poverty and subsistence[14] among the population between 2015 and 2018, following the impact of COVID-19 these indices increased to around 23.7% and 9.9% of the population, respectively, in the first semester of 2021 (PSA data). This translates to 26.14 million Filipinos who lived below the poverty threshold of 12,082 PhP per month for a family of five and 10.94 million Filipinos whose income was not enough to meet even basic food needs.

The vast majority of these individuals were located in Mindanao and the Visayas (Figure 3).

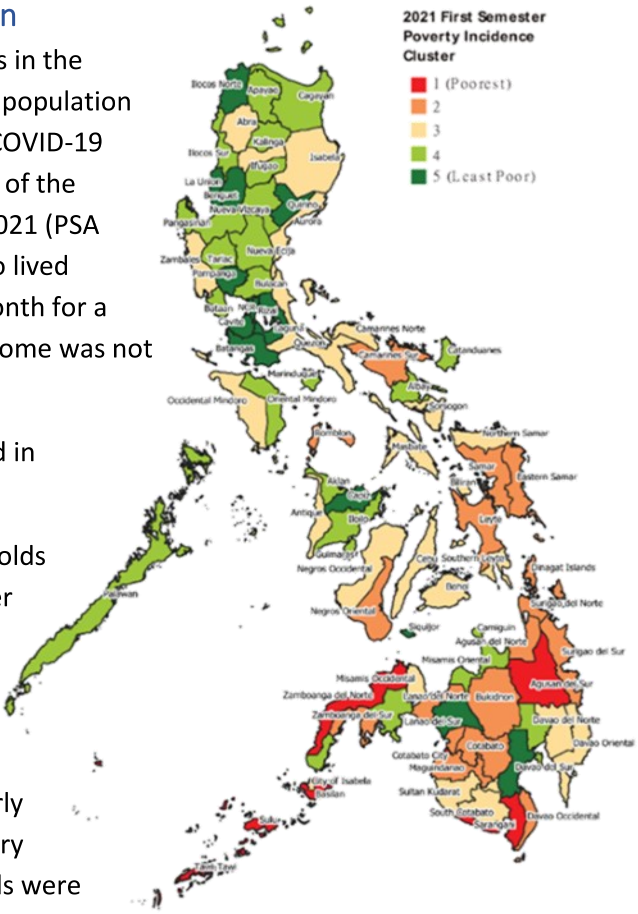

Figure 3: Distribution of the poor in the first semester of 2021. Source: PSA 2021 First Semester Official Poverty Statistics.

In 2018, more than half (53.9%) of Filipino households experienced food insecurity (see Box 1), with larger households comprising more than 5 individuals less food secure than smaller households with <5 persons (Table 2). Rural households were less food secure than urban households (Table 2) and the incidence of food insecurity was particularly high among households headed by farmers, forestry workers, and fishers, whereby 70.2% of households were food insecure in 2018 (DOST-FNRI, 2020). These households experienced some or all of the following: eating fewer meals in a day or reducing the number of meals in a day, having no food of any kind in the household, going to sleep hungry or went a whole day and night without eating because there was no food or money to buy food. Accordingly, it is unsurprising that households headed by fisherfolk have one of the highest rates of malnutrition among young and school-aged children in the country (Capanzana et al., 2018).

Box 1: Definition of Food Security and Insecurity

Food security exists when all people at all times have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996).

Food insecurity is the state in which people are at risk or actually suffering from inadequate consumption to meet nutritional requirements as a result of the physical unavailability of food, their lack of social or economic access to adequate food, and/or inadequate food utilization (Global Forum on Food Security, FAO).

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[14] Poverty incidence: The proportion of families/individuals with per capita income below the poverty line (i.e., the minimum income required to meet basic needs), relative to the total population.

Subsistence incidence: The proportion of families/individuals with per capita income/expenditure less than the per capita food threshold (i.e., the minimum income required to meet basic food and nutrition needs), relative to the total population.

High commodity prices, especially of the food staple rice relative to the rest of the southeast Asian region, further exacerbate this situation (Briones et al., 2017), as do frequent natural disaster events, which have disproportionately perpetuated hunger and malnutrition among poor communities (Holden & Marshall, 2018). In 2021, the World Risk Index ranked the Philippines as the 8th most at-risk country in terms of potential impacts of climate change (Aleksandrova et al., 2021).

Table 2: Food security status of Filipino households according to 2018-19 Expanded National Nutrition Survey by DOST-FNRI.

Socio-demographic characteristics	**Food Security Status**			
	Food secure (%)	Mildly food insecure (%)	Moderately food insecure (%)	Severely food insecure (%)
Household size				
>5	37.9	12.6	33.4	16.2
<5	49.6	12.2	26.9	11.4
Place of residence				
Rural	38.7	12.7	34.1	14.5
Urban	53.7	11.8	23.4	11.1
Wealth quintile				
Poorest	18	11.4	42.9	27.7
Poor	29.4	13.6	40.7	16.3
Middle	42.6	15.2	30.9	11.4
Rich	62	13.6	19.3	5.1
Richest	84.1	7.3	7.1	1.5
Educational attainment				
No grade completed	18	6.6	35.5	39.9
Elementary level	31.8	13.1	36.4	18.7
At least high school level	46.2	13.5	29.4	10.8
At least college/ university level	71.5	8.9	14.9	4.7

Source: DOST-FNRI (2020).

The Philippines failed to achieve its Millennium Development Goals target of halving childhood malnutrition by 2015 and malnutrition remains prevalent among many sectors of the population. Children under the age of five are considered particularly vulnerable to health impacts of malnutrition, with concomitant effects that can persist into adulthood, such as chronic non-communicable diseases and reduced work productivity (DOST-FNRI, 2020). In 2018, it was estimated that 30.3% of children under-five were stunted or suffered chronic malnutrition in the Philippines (albeit this represents a 3.4% decrease from the 2015 estimate; DOST-FNRI, 2020). The prevalence of underweight and stunted children was particularly high among households in the poor to poorest wealth quintiles (underweight: 21.2-30.9%, stunting: 33.4-46%), and among those in rural areas (underweight: 22.6%, stunting 34.3%), compared to their richer, urban counterparts (DOST-FNRI, 2020). Higher prevalence of underweight and stunting in poor households located in rural areas were also evident for school-aged children (5-10 years old) and adolescents (10-19 years old), and chronic energy deficiency (CED) for adults (>20 years) (DOST-FNRI, 2020). It is worth noting that the impacts of malnutrition and stunting go beyond health outcomes, whereby undernutrition has been estimated to reduce GDP by 11% (International Food Policy Research Institute, 2016).

In 2018, the prevalence of anemia across the Philippine population was estimated to be 11.3%. For the past 25 years, anemia among infants six months to less than one year old remained high and was still of severe level in 2018 (48.2% of this demographic group). Conversely, anemia was considered only a moderate public health concern among elderly and pregnant women. On iodine status, almost all Philippine demographic groups surveyed in 2018 had adequate iodine intake, except for lactating mothers aged 15-19 years (94 µg/L) and pregnant women (121 µg/L) for which iodine deficiency remains a public health concern. Vitamin A deficiency was considered a moderate public health concern for preschool children aged six months-5 years old and it is evident that there has been no significant improvement in the incidence of vitamin A deficiency for this demographic group in the past decade. There was mild prevalence of vitamin A deficiency among lactating mothers (2.3%) and pregnant women (3.2%), and low prevalence among the elderly (1.1%) and non-pregnant/non-lactating women (1.3%) in 2018. In general, poor households and households residing in rural areas of the Philippines have higher prevalence of micronutrient deficiencies, namely anemia, iodine deficiency, and vitamin A deficiency (DOST-FNRI, 2020).

While a regional analysis of the 2018-19 ENNS is yet to be undertaken, results of the 2015 DOST-FNRI Anthropometric Survey indicated that children and adolescents in southern regions of the country generally had higher incidence of underweight and stunting than their counterparts in northern regions (Figure 4a-c). There was no clear regional trend in the incidence of wasting in young children (<5 years), but higher incidence of wasting in older children (5-10 years) and in adolescents was evident in northern and central regions of the Philippines (Figure 4a-c). The incidence of CED among adults was variable among regions but was generally higher in northern and central regions of the country (Figure 4d).

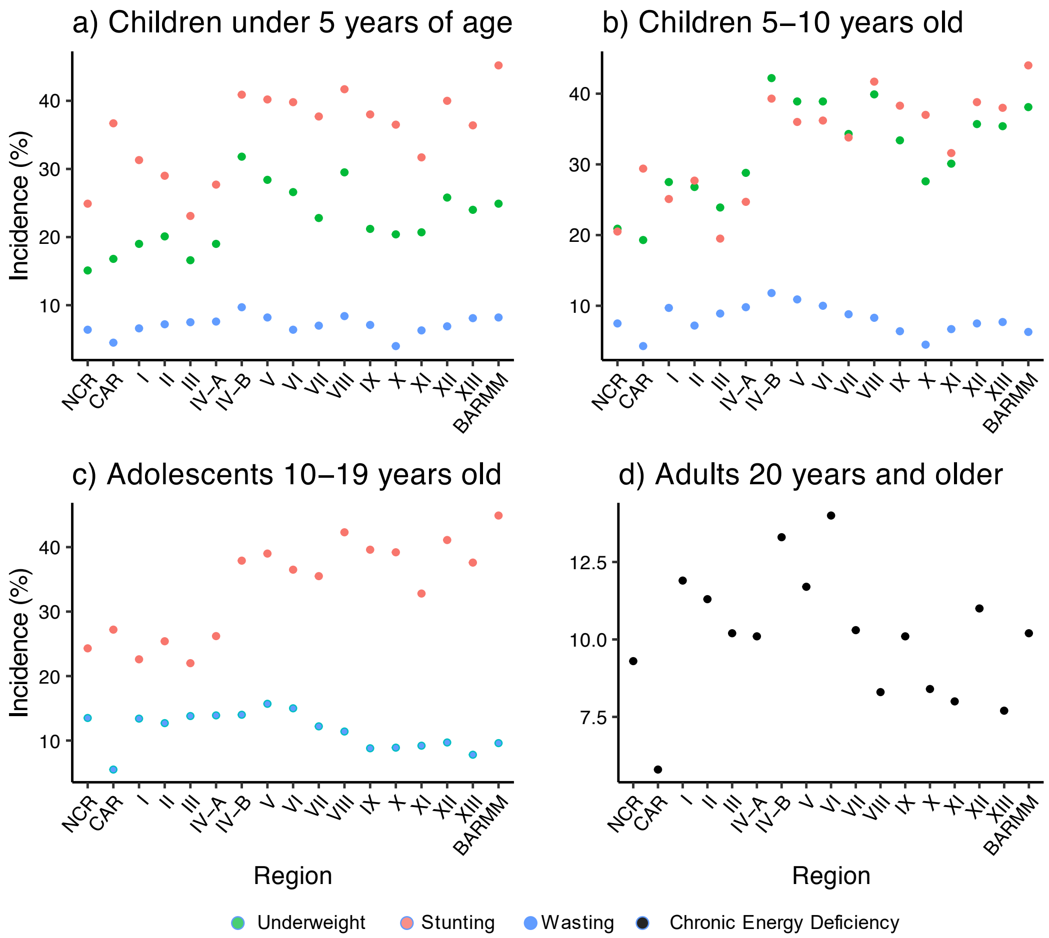

Figure 4: Incidence of underweight, stunting, wasting, and chronic energy deficiency in 2015 among administrative regions of the Philippines for (a) children <5 years of age, (b) children 5-10 years old, (c) adolescents 10-19 years old, and (d) adults >20 years old. Data sourced from DOST-FNRI 2015 Anthropometric Survey.

2.3 The Importance of Seafood and Fisheries to Food Security

In the Philippines, seafood is a cheap and accessible source of animal protein, rich in critical micronutrients, such as iron, zinc, vitamin A, and omega 3 fatty acids. As such, seafood has significant potential to contribute towards alleviating food insecurity, malnutrition, stunting, and cardiovascular disease, while strengthening the immune system and improving maternal and childhood health outcomes. Specific benefits of seafood consumption over other sources of animal protein include:

- Seafood has higher relative protein content than most terrestrial meats (Tacon & Metian, 2013).
- Seafood proteins are highly digestible (Tacon & Metian, 2013).
- Seafood is generally leaner than terrestrial meats on an edible fresh weight basis (Tacon & Metian, 2013).
- Seafood contains the highest concentration of long-chain omega-3 polyunsaturated fatty acids of any foodstuffs (Sargent & Tacon, 1999).
- Seafood products are a richer source of most essential minerals and trace elements than most terrestrial meats (Tacon & Metian, 2013).
- Aquatic animal food products are a richer source of several key water- and fat-soluble vitamins than most terrestrial meats (Solhelm, 2010).

Seafood is an important source of protein in the Filipino diet, accounting for 42.2% of total animal protein intake and 18.3% of total protein intake[15]. Accordingly, the Philippines has long been ranked among the top 10 fish producing countries in the world, with the various fishery sectors (see Box 2) a strategically important factor both in terms of food security and livelihoods.

[15] DOST-FNRI data from the 2018-19 Expanded National Nutrition Survey

Box 2: Philippine Fishery Sectors - A Brief Overview

The Philippine fishing industry comprises both marine and inland fisheries.

As defined by Presidential Decree No. 704 of July 14, 1975, marine fisheries can be further divided into commercial fisheries and small-scale artisanal fisheries, referred to as 'municipal fisheries' in Philippine parlance. Municipal fisheries operate in marine waters within 15 km of the coastline using vessels ≤3 gross tons (GRT) or no vessel at all, while commercial fisheries operate outside municipal waters, using vessels >3 GRT. In addition, the implementation of the Handline Fishing Law (RA 9379), provides a separate category for commercial handline vessels which were formerly considered municipal fishing vessels.

Municipal fisheries also occur in inland waters such as lakes, reservoirs, and rivers. As such, in this report we separate inland municipal fisheries from marine municipal fisheries. While not all municipal fishers would strictly meet the definition of 'subsistence fishers' (i.e., where earnings fall below the food threshold and catch is used for a combination of family consumption, barter, and sale) these terms are almost interchangeable in the Philippines.

The commercial fleet is managed by the Philippine Department of Agriculture - Bureau of Fisheries and Aquatic Resources (hereafter DA-BFAR), which is responsible for the coordination of commercial fishery licenses, taxes, levies, and collection of fisheries data via monthly reports from registered (licensed) vessels as promulgated in the Presidential Decree No. 704 and by the Philippine Fisheries Code of 1998. Municipal fisheries fall under the jurisdiction of the local municipal government, for which DA-BFAR acts as a technical advisory body.

Aquaculture refers to the farming of aquatic organisms in fresh, brackish, and marine waters, whether that be in ponds, pens, cages or on substrates such as stakes, ropes, lines, nets, shells, or on a demarcated natural environment using seedstock, which may be naturally occurring or artificially produced in hatcheries.

Recreational fishing is occasionally practiced by tourists, but generally recreational fisheries have not developed in the country. Gleaning (i.e., the gathering of shellfish and invertebrates across the inter-tidal zone, with or without tools) is exempt from the definition of fishing in the 1975 Act and the 1998 Code. As such, recreational fishing and gleaning is not covered in detail by this report. Nevertheless, we discuss the undocumented and likely underappreciated nature of gleaning for food security in Chapter 5.

Yet, despite the cultural, livelihood, and food-related importance of productive fisheries, wild fish stocks have long been subject to overexploitation in the Philippines due to ineffective management and overcapacity. The number of commercial vessels registered in the Philippines has increased 3-fold from about 2,100 during the 1960s to 7,442 commercial vessels in 2019. At the same time, increased efficiency of boats and gears has resulted in a 4-fold decline in the number of fishers per boat, and thus loss of employment in many coastal communities (DA-BFAR, 2020a; Palomares & Pauly, 2014). Over the past 6-7 decades commercial fisheries have also expanded offshore, resulting in a shift in target species from predominantly demersal to mainly offshore pelagic species, and a 5-fold increase in the catch per fisher (Morgan & Staples, 2006; Palomares & Pauly, 2014). The overexploitation of targeted stocks subsequently caused gross commercial production volume to level off in the early 1990s and production volume this century has been gradually declining through time (Figure 5). The burgeoning number of municipal fishers have long competed with the commercial sector for dwindling resources, as evident by the small and declining catch/day of individual fishers over the past 4-5 decades (Dalzell et al. 1987; Muallil et al. 2012, 2014; Palomares and Pauly, 2014; Lavides et al., 2016).

Under these circumstances, the Philippines increasingly turned to aquaculture in order to sustain the growth in seafood supply for the growing population. Substantial expansion of the aquaculture sector occurred during the 1990s and early 2000s (Figure 5) due to financial and technological assistance from multilateral organisations (e.g., Asian Development Bank) and government sources (DA-BFAR, NFRDI). Nevertheless, the development of the aquaculture was at times unsustainable and came at the cost of natural resources, resulting in concomitant social, economic, and livelihood issues. In the past decade, a scale-back in government assistance, water quality problems, and disease have resulted in the reduction of pond efficiency on a per hectare basis (CRMP, 1998; Cruz-Trinidad, 2003; Guerrero, 2019; PSA data). As a result, the gross production volume obtained from the aquaculture sector has also been declining since 2010 (Figure 5).

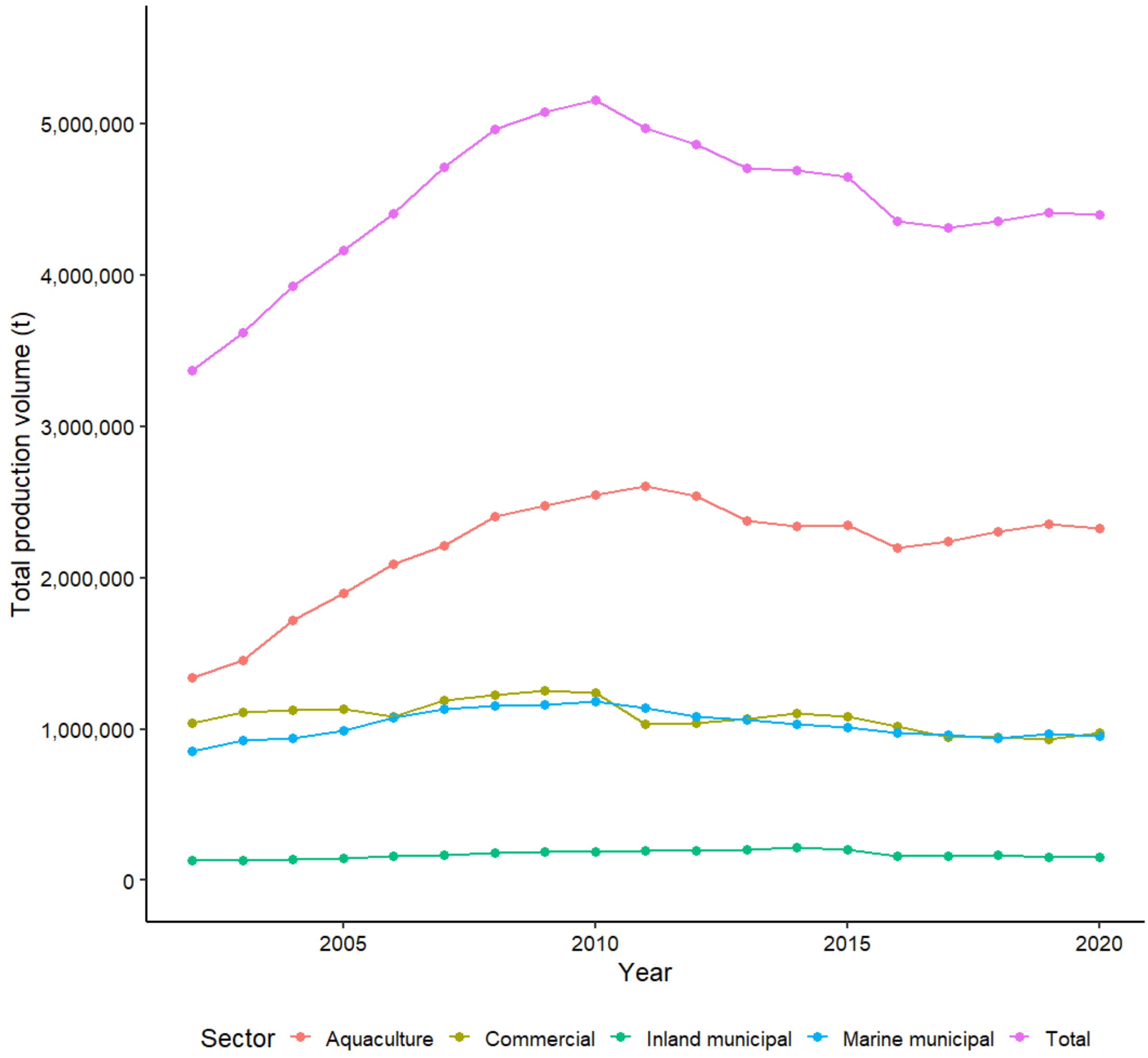

Figure 5: Gross production volume reported between 2002 and 2020 for the various Philippine fishery sectors considered in this report. Colours as per legend. Data source: PSA.

3 The Contribution of Philippine Fisheries to Employment and Income

Fisheries contribute substantially to the economic and social fibre of the Philippines, providing employment to over 1.95 million people engaged in fish-related activities (DA-BFAR, 2020a). In 2019, the Philippine fisheries sectors were estimated to contribute 228 billion PhP (≈US$4.34 billion[16]) to the national economy, comprising 1.2% of the Philippines GDP at current prices (DA-BFAR, 2020a). The foreign trade performance of the seafood industry registered a net surplus of US$377 million in 2019, primarily through the export of tuna, seaweeds, and shrimp/prawn, which cumulatively accounted for 68.5% (US$770.3 million) of the total export value (US$1,125 million; DA-BFAR, 2020a). The FAO estimates that fish production will continue to increase in the Philippines until at least 2030, primarily through growth in the aquaculture sector (FAO, 2020). In contrast, as shown in Figure 5 above, national estimates indicate that the gross volume of fishery production is declining because many wild stocks have reached their maximum production level or are overexploited, and aquaculture production is declining due to a scale-back in government assistance, water quality problems, and disease outbreaks. Not only does declining fish supply affect food security (see Chapter 4), but it also impacts the viability of fishing as a form of employment and income. This is particularly true for those engaged in the commercial and marine municipal fisheries sectors, which despite being separated by spatial boundaries, compete directly for the same dwindling fish stocks.

3.1 Employment in Philippine Fisheries

Fishing is a major industry in the Philippines, providing direct employment to around 1.35-1.41 million workers[17,18] and indirectly employing around 537,872 individuals engaged in fish-related activities[19]. It should be acknowledged, however, that there is significant uncertainty surrounding these estimates, which stems from the classification of fishing based on the size of the fishing vessel alone (that is, < 3 GT is municipal, > 3GT is commercial) and the classification of commercial fishers who also engage in municipal fishing as municipal fishers to "avoid double counting" (Vera & Hipolito, 2006). This has resulted in a very small number of commercial fishers relative to municipal fishers in national estimates (Table 3) and has confounded our understanding of the number of commercial fishers, given that logic suggests the commercial sector must employ far more individuals than national estimates indicate in order to support the current (and historical) level of fish production. There also appears to be some potential confusion among the various government departments which estimate the number of fishers, or those employed in fishing industries. For example, DA-BFAR reports that 36,129 individuals were engaged in fish processing in 2019 which represents a significant annual jump from the estimated 18,544 engaged in fish processing according to the PSA 2018 *Census of Philippine Business and Industry* [20]**.** Similarly, DA-BFAR (2020a) estimates that around 1.17 million people are engaged directly in fishing across capture fisheries and aquaculture, with an additional 146,980 people involved in fish processing and fish vending, which is considerably less than the 1.35 million fishing and aquaculture workers estimated by the PSA 2020 *Labour Force Survey.*

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[16] Using exchange rate at time of writing: US$1 = 52.59PhP

[17] ≈1.35 million: Table 6, PSA 2020 *Labor Force Survey.*

[18] ≈1.41 million: DA-BFAR (2020a).

[19] Fisherfolk engaged in fish vending, processing, and "Others": DA-BFAR, 2020a

[20] Table 1, 2018 PSA *Census of Philippine Business and Industry*

While DA-BFAR do not differentiate the number of municipal and commercial fishers in their annual fisheries reports, data from the 2012 national Census of Agriculture and Fisheries (CAF) indicate that most workers were engaged in the municipal fishery sector (Table 3). While we acknowledge this data is clearly dated, the CAF has been undertaken every 10 years since 1971 and thus these data are expected to be updated in 2022. Nevertheless, due to the conflation of commercial and municipal fishers evident in previous census (discussed above), it is likely that the true number of municipal fishers will remain unclear.

Table 3: Number of fishers estimated for each sector by the 2012 Census of Agriculture and Fisheries and cumulatively across capture fisheries in 2019 by DA-BFAR.

Most recent estimates provided by Philippine Statistics Authority			Most recent estimate provided by DA-BFAR		
Sector	Year of estimate	Total number of fishers	'Fishing activity'	Year of estimate	Total number of fishers
Municipal	2012[1]	791,236	Capture fishing (i.e., municipal + commercial)	2019[3]	957,551
Commercial	2018[2]	15,644			
Aquaculture	2012[1]	131,312	Aquaculture	2019[3]	217,198
			Fish vending	2019[3]	110,851
			Gleaning	2019[3]	241,138
			Fish processing	2019[3]	36,129
			Others	2019[3]	390,892
			Total	**2019[3]**	**1,953,759**

1: Philippines Statistics Authority: 2012 *Census of Agriculture and Fisheries.*
2: Philippines Statistics Authority: 2018 *Census of Philippines Business and Industry.*
3: DA-BFAR (2020a)

3.1.1 Municipal sector

The significant uncertainties in national employment data discussed above and dated estimates of sector-specific employment make it difficult to provide a robust discussion surrounding the contribution of particular regions or fishery target species to employment. Nevertheless, it is clear most fishers are engaged in municipal fishing, specifically using boats in the marine municipal sector (Figure 6a). At a regional scale, the 2012 CAF indicated that most municipal fishers were located in Bicol (Region V), Eastern Visayas (Region VIII), and MIMAROPA (Region IV-B) regions, respectively (Figure 6b).

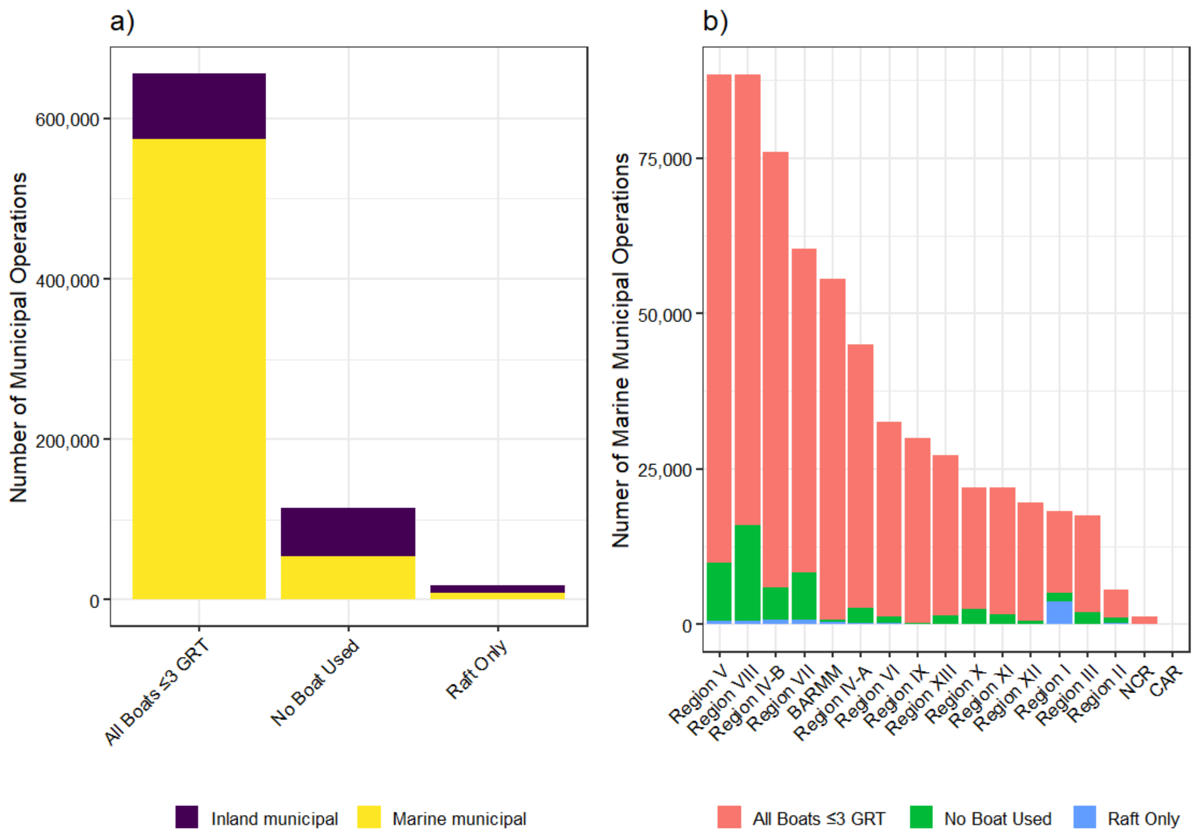

Figure 6: Number of municipal operations using boats (a) and the location of residence of municipal operators (b). Colours appear as per legend. Data source: PSA 2012 Census of Agriculture and Fisheries.

It should be noted that estimates on the number of municipal fishing operations from the 2012 CAF are significantly greater than the number of municipal fishing boats which appeared on the DA-BFAR Fisherfolk Registration in 2019 (e.g., see DA-BFAR, 2020b; Coastal Resources Center, 2021). This occurs because there are few incentives, if any, for fishers to register their vessels with local government units and there is little-to-no targeted compliance of fisher registration. A recent study estimated that unregistered municipal fishing vessels amounted to 30-47% of the number of registered municipal fishing vessels, which translates to 79,726-124,904 unregistered municipal vessels in 2019 (Coastal Resources Centre, 2021).

There are no disaggregated statistics on municipal fisher employment according to target species. However, it is evident that municipal fishers obtain significant value from scombrids (tunas and mackerels) and carangids (jacks and scads) at both a national and regional level (see Chapter 3.2). Similarly, Muallil et al., (2014) interviewed 6,488 municipal fishers in 44 towns/ municipalities across all six biogeographic regions of the Philippines and showed that these taxonomic groups also dominated catches. Accordingly, these taxonomic groups appear important in terms of supporting municipal fisher employment. Nevertheless, it is also important to recognise that municipal catches are often generalist in nature and comprise demersal species in addition to pelagics. For example, over half (51% +/- 21%) of fishers interviewed by Muallil et al., (2014) caught demersal species to supplement their food supply and income. Consistent with this we show that several demersal species play important roles in supporting municipal fisher incomes in Chapter 3.2. The exploitation of demersal fishes by the municipal sector may also provide an important ‘safety net’ in terms of food security and livelihoods, given that demersal fishes often occupy coral-reefs which are common within municipal waters, and that carangids and scombrids are also the primary targets of the commercial sector and thus subject to significant fishing mortality from both sectors.

3.1.2 Commercial sector

Due to the conflation of commercial and municipal fishers to 'avoid double counting' (discussed above in 3.1.1), national estimates indicate that the commercial sector employs far fewer individuals than aquaculture (Table 3). In reality however, it is likely that the commercial fishery sector actually employs more individuals than aquaculture and thus provides the second greatest amount of employment, following that of the municipal sector.

In the commercial sector, most employment can likely be attributed to tuna fishing and the subsequent transport, processing, canning, and export of tuna catch. Most tuna-related jobs are in General Santos City, which is known as the 'tuna capital of the Philippines' and is the location of the primary tuna landing port (the GSFPC), 6 tuna canneries, and 12 frozen tuna processors (which support around 3,000 jobs; WCPFC, 2020). DA-BFAR (2018) reports that General Santos City alone is home to >200,000 individuals engaged in the tuna industry and around 100,000 individuals are employed directly as fishers in Mindanao. While DA-BFAR (2018) estimates also include municipal fishers and the actual number of commercial fishermen involved in the Philippine tuna fishery is not reported, it is reasonable to assume that the majority of commercial fishers are engaged in the commercial tuna industry given that tuna are among the most valuable commercial targets (see chapter 3.2), tuna are fished in both domestic and international waters (unlike other high-value producing commercial targets, such as round scad and sardines, which are fished in the EEZ), Philippine nationals are common workers aboard tuna vessels in the WCPO, and the beneficially-owned Philippines purse seine fleet of 91 vessels is collectively the largest in the WCPO in terms of vessel numbers (Havice et al., 2019). Commercial tuna fishers primarily work on purse seine and ring-net boats, with the handline sector employing an additional 40,000 fishers to crew its 2,500 outrigger boats which fish within the Philippine EEZ (DA-BFAR, 2018). Tuna fisheries operate year-round.

A substantial number of commercial fishing workers are also engaged in the sardine-industry. The Zamboanga Peninsula sardine industry is the largest in the country and directly employs around 3,000 fishers, doubling to 6,000 people during peak season (DOLE, 2014). If fish-related jobs such as sardine tin production, canning, and bottling are also accounted for, the industry is estimated to benefit approximately 35,000 people (DTI., 2013, 2014). Unlike tuna, sardines have a 3-month closed season imposed annually to protect spawning biomass in the in the Sulu Sea, (i.e. around Zamboanga peninsula down to the Sulu Archipelago) which is the major fishing grounds for sardines in the country. The Visayan Seas, northern Mindanao, San Bernardino strait, and waters around Palawan are also important fishing grounds for sardines and 3-month closed seasons are also enforced annually in the Northeast Palawan Sea (November to January) and the Visayan Sea (November to January) to protect small-pelagic stocks. During the closed fishing season fishers must find alternative livelihoods, with most employees in Zamboanga taking up skilled-labour jobs, working as fish vendors or as sardine processing workers (Brillo et al., 2019). As such, most households engaged in the Zamboanga Peninsula sardine industry have multiple sources of income (≈ 80%; Brillo et al., 2019). The 3-month closure also impacts the nature of employment in the sardine industry, with more than two thirds of workers interviewed by Brillo et al., (2019) employed under contractual arrangements or paid depending on the volume processed. While these arrangements do not offer the benefits and wage stability of permanent employment, non-permanent work arrangements allow fish-workers to engage in alternative livelihoods during the sardine closure, when only a fraction of sardine processing jobs persist. Most (around 80%) of sardine processing workers are then rehired after the 3-month closure, with little to no change in the duties performed, the number of working hours, or income (Brillo et al., 2019). Although Brillo et al., (2019) estimated that fishers forewent an average of 14,230 PhP in income during the 3-month closure period, overall fisher incomes per fishing day and the number of fishers employed are estimated to have increased in Zamboanga Peninsula since the seasonal small-pelagic closure was enacted (albeit the average income of those working in canneries, bottling facilities, and tin can production has reportedly dropped; DA-BFAR, 2020b; Narvaez, 2017).

It is also expected that a significant number of fishers are employed in commercial round scad fisheries, given the economic importance of this species and its prevalence in the diets of Filipinos. However, publicly available data on the number of people employed in round scad fisheries are scarce and we could find no robust estimates of employment in commercial fisheries for this species. It is worth noting that the Philippine Fisheries Development Authority recently began holding Galunggong (round scad) Summits in order to generate data to construct a five-year national management plan, similar to that which exists for sardines (Francisco, 2019). This plan may provide similarly useful information on employment and income, when developed and published.

3.1.3 Aquaculture sector

DA-BFAR (2020a) estimates that 217,198 people are directly employed in the aquaculture sector. However, the total number of Filipinos involved in aquaculture and more specifically the culture of certain species is debatable because there are no recent disaggregated statistics. For example, contrary to national estimates, Asian Development Bank (2004) reported that at least 280,000 people, directly or indirectly benefit from employment generated by the freshwater tilapia industry alone (not including labour required for tilapia processing and distribution, or associated industries such as tilapia feed processing, fertilizer, and other supplies). Similarly, CGIAR (2006) reported that *“Almost 300,000 people in the Philippines alone now benefit directly or indirectly from employment in the tilapia industry”.* While it is unclear how these authors arrived at this estimate, if true, it is inconsistent with DA-BFAR (2020a) estimates on the number of people currently employed in the aquaculture sector (Table 3), especially given the significant rise in the number of aquaculture operations over the past two decades.

Reliable estimates on the number of aquaculture workers and recent disaggregated statistics on the culture environments and species are lacking likely due to the private and commercially sensitive nature of aquaculture operations which mostly occur on privately owned land. This is somewhat unsurprising given the lack of reliable employment data collected for wild capture fisheries, which are government managed and occur in publicly accessible waters. Nevertheless, we note that the top aquaculture species produced in recent years (by volume) were seaweeds, tilapia, and milkfish (DA-BFAR, 2020a). As such, it is likely that these cultured species groups account for the greatest employment of the aquaculture sector.

In terms of the nature of employment in the aquaculture sector, we understand that medium to large aquaculture farms employ both permanent full-time workers and seasonal contract workers for pond preparation, stocking, and harvesting. Conversely, small-scale pond and cage farms or backyard-style operations rely mainly on family labour. For smaller operators, exchanging labour among community members in the absence of financial compensation is also common, as is payment in the form of cultured seafood.

3.2 Economic Contribution of Philippine Fisheries

The contribution of fisheries to the Philippines economy can be assessed at two levels: (i) the contribution of fisheries sectors and target species to the national economy examined through the value of production, at both a national and regional level, and (ii) the economic contribution of fisheries sectors and target species to individual fisher incomes.

3.2.1 Gross Value of Production

Since 1987 official fishery statistics for the Philippines have been compiled by the Philippines Statistics Authority (formally the Bureau of Agricultural Statistics), based on probability (stratified random sampling by data collectors) and non-probability surveys (interviews by regular PSA staff), supplemented by secondary data from administrative sources (e.g., landings sites and ports). Annual fisheries statistics for commercial, municipal (marine and inland), and aquaculture sectors are published for three-year time frames and include data on the volume and value of production by taxonomic group and region, information on fish prices, and foreign trade statistics. DA-BFAR also publish annual fishery profiles for the various fishery sectors which provide an overview of fish production volume and value, in addition to exports, imports, fish prices, and levels of fish consumption (e.g., DA-BFAR, 2020a). Estimates of catch are also made by the National Stock Assessment Program (NSAP) via extrapolation of data collected during their independent subsampling of landings.

Like data on fisheries employment, there are several discrepancies relevant to national fisheries production data. Firstly, discrepancies in catch data are evident between DA-BFAR, PSA, and NSAP (for example see page 22 of DA-BFAR, 2020b). Secondly, large discrepancies are also evident in export data reported by the Philippine Statistics Authority and that which appear in the United Nations (UN) Comtrade and CEPII BACI international trade databases, which assign exports to countries based on the reports provided by importing countries to the UN, as well as reports from exporters (i.e., the Philippines). For example, the Philippines Statistics Authority *Foreign Trade Statistics of the Philippines* 2019 publication indicates that only 59t of sardines were exported from the Philippines in 2019, while international trade databases indicate that 7,858.47t - 8,794.35t worth of sardines (HS code 160413) were exported from the Philippines to various foreign markets in 2019. Such large discrepancies between national reports and world trade databases not only hinders our understanding of the value obtained from commercial fisheries production, but also obscures the contribution of commercial fisheries landings to domestic food security. Further studies are required to validate the quantity and value-chains of Philippine fish exports and imports.

Finally, it is important to understand caveats of the survey protocol for the collection of landings data prior to reviewing trends. Firstly, the Philippines port-based sampling program records landed catches, irrespective of where they were caught, and therefore does not separate landings from foreign-flagged vessels or from catches taken on the high seas or in foreign waters (WCPFC, 2020). Another complexity is that many small-scale commercial vessels are registered as municipal boats in the Philippines and purse seine, ringnet, large-scale longline, and tuna handline gears are the only gears considered ‘commercial’. This means that catch from small commercial boats using other gears (e.g., hook and line, small-scale longline, gillnet, troll, bagnet, beach seine) are recorded as municipal catch (NFRDI et al., 2021). Third, port-based landed-catch monitoring likely underestimates the landings of municipal fishers considering many do not land their catch in established fish ports, sell their catches directly within the local community, or consume their catches as subsistence (Cabral & Geronimo, 2018). Finally, a recent qualitative estimate of Illegal, Unreported, and Unregulated fishing (IUU) in the Philippines indicated that around 274,000-422,000t of commercial landings per year are underreported or not reported officially to DA-BFAR (Coastal Resources Centre, 2021).

Nevertheless, national statistics on fish production have been supplemented by numerous independent research projects, which provide a means of validating a subset of the national fisheries data. Below we review both national data on fisheries production value and independent studies from the grey and peer reviewed literature in order to ascertain the likely 'real' contribution of each fisheries sector, target species, and region in terms of the gross value of production. In doing so, we consider methods of catch utilization, trends in economic trade, and evidence of stock depletion that may impact the present and future economic contribution of key target species.

3.2.1.1 National level, across sectors

In 2020, the Philippines reported ≈4.4 million tonnes of total seafood production across sectors, valued at approximately 273 billion PhP (US$5.2 billion; PSA, 2021). Between 2018 and 2020 wild capture fisheries cumulatively accounted for around 58% of gross production value, with the commercial sector contributing 23% and the municipal sector (marine and inland) accounting for 35% of total production value (Figure 7). The aquaculture sector contributed 42% of gross production value between 2018 and 2020 (Figure 7).

Across sectors, the top 15 most valuable taxonomic groups in terms of average annual production value between 2018-2020 are shown in Figure 8.

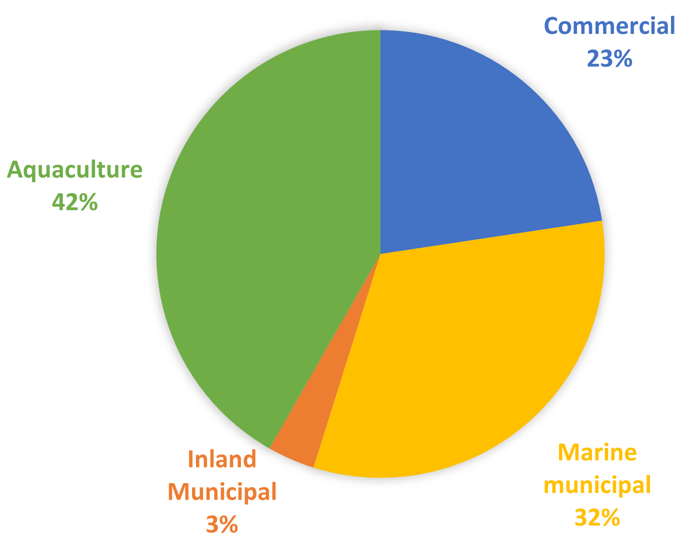

Figure 7: Relative contribution of fishery sectors to overall production value, based on data from 2018-2020. Data source: PSA.

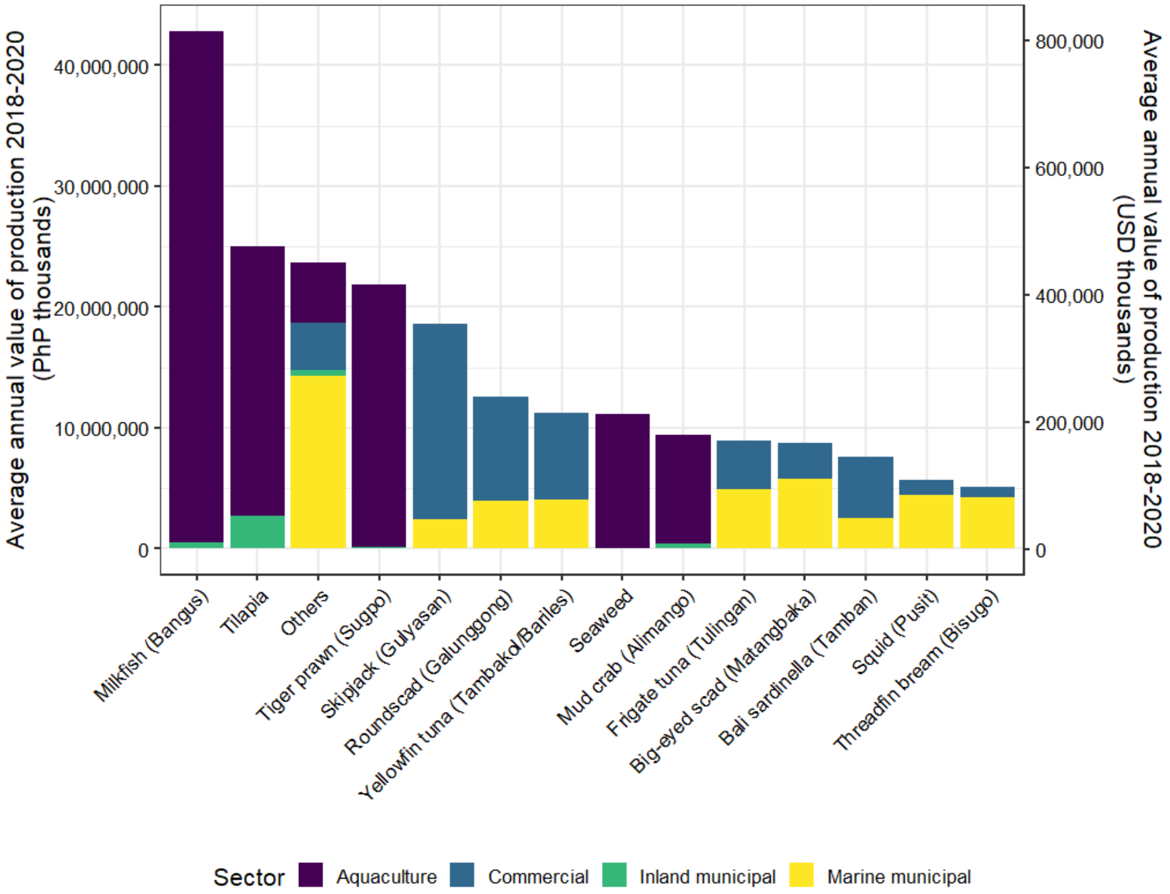

Figure 8: Top 15 most valuable taxa according to average annual production value between 2018 and 2020. Colours as per legend. Conversion rate at time of writing: US$1 = 52.59 PhP. Data source: PSA.

There is little data available on species composition within these taxonomic groups, which unfortunately hinders our understanding of species- and stock-specific exploitation. This is particularly so for the "Others" species group (ranked 3rd overall), which likely contains various small pelagic, coastal, and coral reef-associated species with diverse life-histories and therefore variable responses to exploitation.

3.2.1.2 Commercial Sector

The top 11 commercial fishery species by production value are shown in Figure 9 and comprise various pelagic species (i.e., tunas, scads, mackerels, sardines), squid, and the "Others" category which likely includes various small pelagics, coastal species such as mullets, garfish, flying fish, and coral reef-associated species (PSA, 2021).

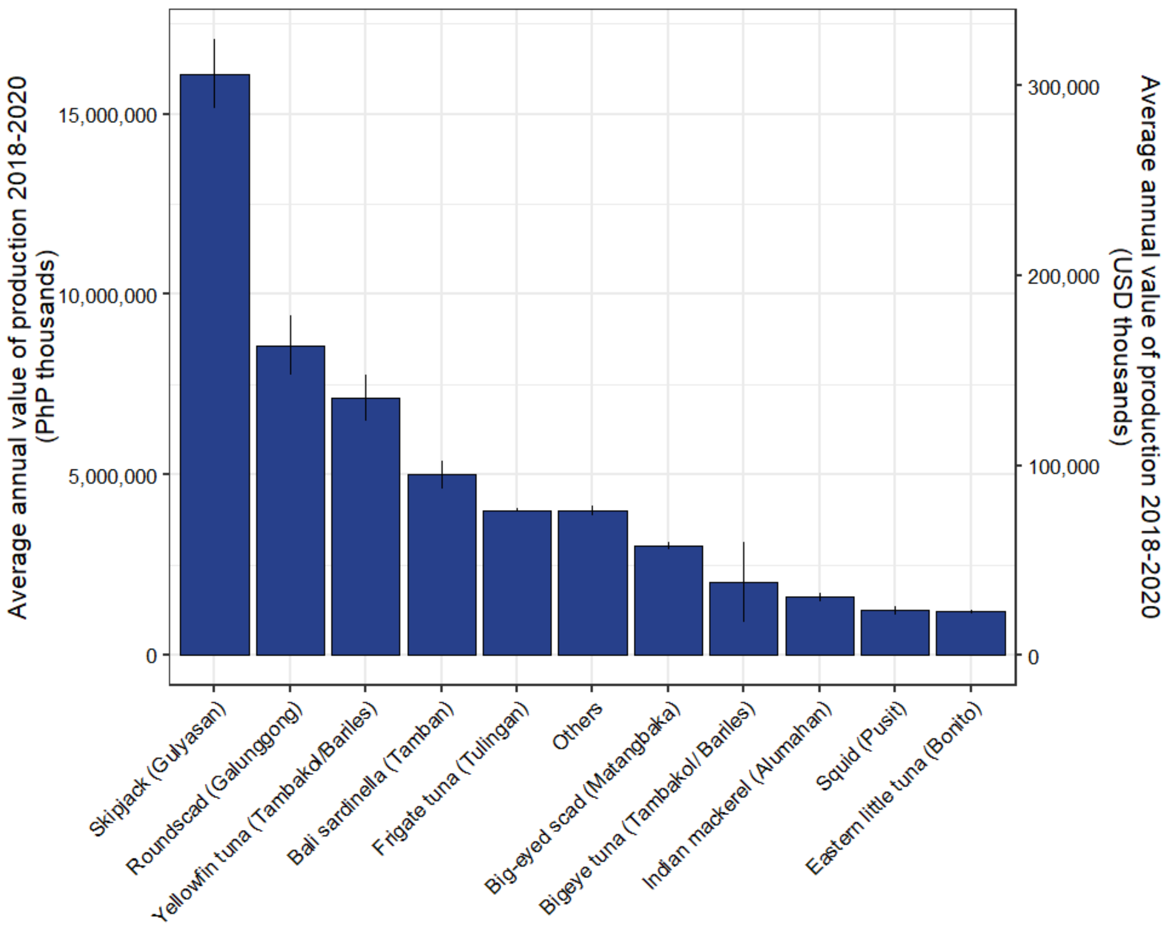

Figure 9: Top 11 most valuable species landed by the commercial sector, based on average gross production value between 2018 and 2020. Conversion rate at time of writing: US$1 = 52.59 PhP. Data source: PSA.

At the national level, skipjack tuna is the most valuable commercially landed species, worth around 1.9 times the value of round scad (ranked 2nd) on average between 2018 and 2020 (Figure 9). However, as mentioned previously, it is important to understand that national data does not separate landings from foreign-flagged vessels or from catches taken on the high seas or in foreign waters (WCPFC, 2020). Moreover, many of the small-scale commercial vessels are registered as municipal boats in the Philippines which further confounds estimates (NFRDI et al., 2021). These issues have long been recognised and since 2008 representatives from DA-BFAR and NFRDI have collaborated with the WCPFC and the Pacific Community (SPC), on an annual basis to review and validate Philippine domestic tuna catch estimates by species and gear type (NFRDI et al., 2021; WCPFC, 2020). Table 4 contains estimates of tuna catch within the Philippine EEZ for 2020, which would suggest the value of domestically caught skipjack was around half the gross landed value reported by PSA (based on volume; Table 4, Figure 9), while around 87% and 67% of total production volume of yellowfin and bigeye tuna, respectively, was domestically caught in 2020 (based on volume; Table 4). In contrast to Figure 9, these data suggest therefore that the production value of domestically caught skipjack tuna is similar to round scad, albeit significant post-capture production value is obtained through processing and export of tuna. The same cannot be said for round scad which remains largely in-country.

Table 4: Estimates of domestic tuna catch in 2020 by gear and species vs. gross production volume reported in national data.

Estimated domestic catch 2020 (t)[1]				Gross commercial production volume 2020 (t) [2]		
Gear/ species	SKJ	YFT	BET	SKJ	YFT	BET
Purse seine	92,677	34,647	2,322	234,521.56	62,648.9	6,005.1
Hook-and-line	9,753	37,391	1,576			
Others	6,724	2,581	137			
Total	109,154	74,618	4,035			

*Estimated domestic catch estimate does not include catches of Philippine flagged purse seine vessels in PNG and other waters which accounts for around 7000t for 2020. SKJ = skipjack tuna, YFT = yellowfin tuna, BET = bigeye tuna.

1: Source: 14th Philippine/ WCPFC Annual Tuna Catch Estimates Review Workshop

2: Source: PSA OPENStat

While the stock status of skipjack, yellowfin, and bigeye tuna throughout the WCPO is healthy, there has long been evidence of population depletion in countries that serve as habitat for juvenile tuna, such as the Philippines (Vera & Hipolito, 2006). This depletion is caused by a combination of excess fishing capacity, the by-catch of juvenile yellowfin and bigeye tunas (among other small fishes) by Philippine purse seine vessels which commonly fish on FADs (i.e., payaos) for skipjack (Harley et al., 2014; Macusi et al., 2015, 2017), and the use of smaller than the standard 3-cm mesh size by commercial fishing vessels (Muallil et al., 2014). Asian Development Bank (2014a) estimated that in the Philippines 92%, 88%, and 38% of bigeye tuna, yellowfin tuna, and skipjack tuna landed, respectively, are juvenile. As such, it is essential not just for the Philippines, but for the health of wider WCPO tuna stocks (which make a substantial contribution to Pacific Island Country economies), to effectively control mortality on juvenile tuna.

Commercially caught tuna (skipjack, yellowfin, and bigeye; ranked 1st, 3rd, 5th) are a key trade commodity for the Philippines, primarily because of the processing power offered by the 8 tuna canneries (6 in General Santos and 2 in Zamboanga) and 17 frozen tuna processors (70% of which are located in General Santos City) (WCPFC, 2020). The estimated 169,000t annual output of the 8 canneries is mostly supplied by landings from Philippine purse seiners and ring netters, both local vessels and via carriers from overseas operations (WCPFC, 2020). In 2019, US$288.78 million (192,098t) of tuna products were also imported, mostly in the form of chilled/ frozen fish from Papua New Guinea, to supplement cannery supply (DA-BFAR, 2020a). This resulted in approximately US$478 million (119,955t) worth of tuna products that were exported from the Philippines in 2019, with canned tuna comprising the bulk of exports (DA-BFAR, 2020a).

Conversely round scad (ranked 2nd) is consumed widely in the Philippines but comprises very little export volume or value (61t worth US$110,000 exported in 2019; DA-BFAR, 2020a). Once considered a "poor man's fish", round scad was a staple of the Filipino diet. However, round scad stocks have long been showing signs of over exploitation (Dalzell & Ganaden, 1987), commercial landings have been declining since at least 2003, and market prices of round scad have risen substantially in recent years (Figure 10). Incursions by Chinese vessels into the Philippines' EEZ have also been reported to contribute to the decline in round scad stocks and domestic landings (Kearns et al., 2021).

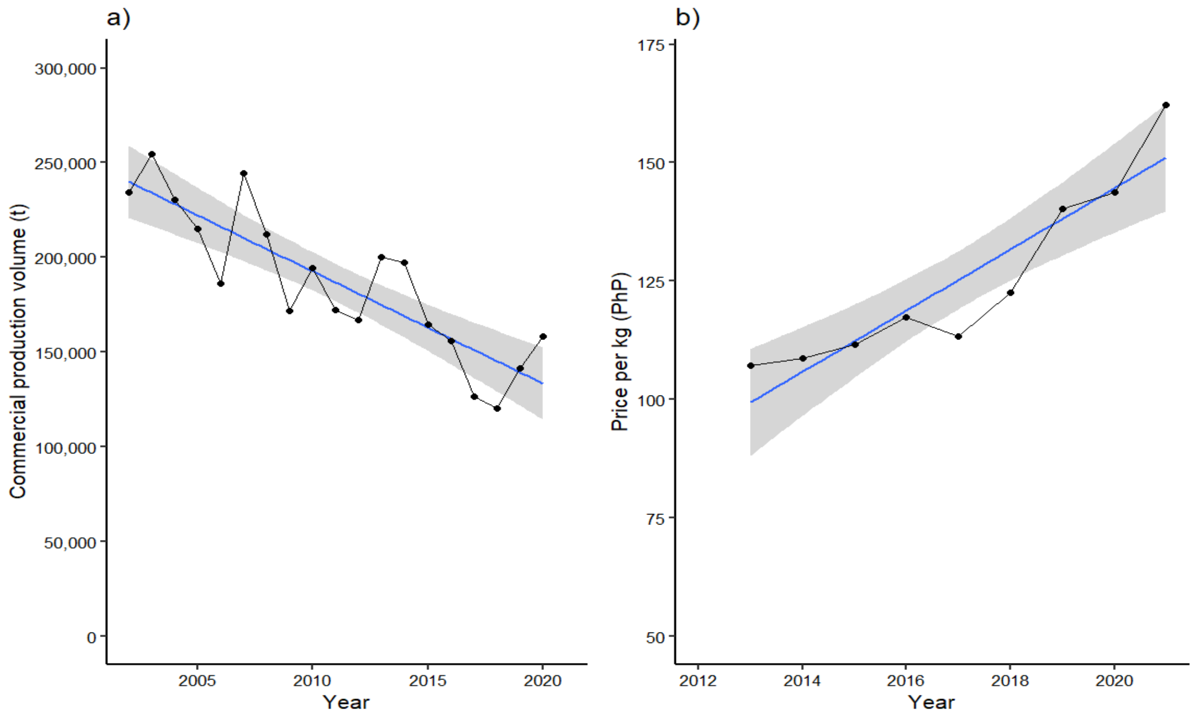

Figure 10: Round scad production volume attributed to the commercial sector from 2002-2020 (a) and market prices per kg from 2013-2020 (b). Data fit with linear models (blue line), with associated 95% confidence intervals shown as grey ribbon. Data source: PSA.

To combat declining production volume, the Philippines started importing round scad from countries like Vietnam, Taiwan, and China as early as 2001, with imports funnelled toward canneries and restaurants. More recently DA-BFAR approved the import of 60,000t of small pelagic fishes, including round scad, directly to wet markets in an attempt to contain increasing market prices (Philippine Department of Agriculture, 2021), albeit reports suggest this tactic has not been effective to date (Dao, 2021). DA-BFAR also enforce annual closed seasons on all fishing activities in the Visayan Sea, around Zamboanga Peninsula (East Sulu Sea, Basilan Strait, Sibuguey Bay), and Palawan to protect small pelagic fishes, including round scad, during their peak spawning season in hopes that production will return to historic values if stocks recover. Nevertheless, we were unable to locate any papers which assessed the effectiveness of seasonal closures on round scad stocks. We note however, that there is mixed evidence regarding the effectiveness of seasonal closures for other small-pelagic species (discussed below for sardines and mackerel). To that end, studies which partition the effect of the seasonal closed season from environmental change on the stock status of small pelagic species are required.

Similar to round scad, the vast majority of production originating from the commercial capture of the remaining species in Figure 9 is retained within the Philippines, with little exports of sardines (i.e., Bali sardinella), big-eye scad, Indian mackerel, squid, or Indo-pacific mackerel relative to production volume (DA-BFAR, 2020a). We also presume little of the "Other" species catch is exported, as this taxonomic group likely comprises diverse species in low volumes. Nevertheless, the unknown composition of this category remains a knowledge gap in terms of quantifying the value of commercial production both in monetary and food security terms, and the impact of fishing on Philippine fish stocks.

While comprehensive stock assessments are lacking for most Philippine fish stocks, it is notable that concerning abundance and catch trends are evident for several sardine, scad, mackerel, and squid species in the Philippines. For example, several species of sardines, including Bali sardinella (*S. lemuru*), have long been overexploited in the western and central Visayas and southeast Luzon, and the landings of big-eyed scad have declined substantially in Surigao del Norte, Caraga (Gomez, 2013; Guanco et al., 2009; Olano et al., 2009a, 2009b). Commercial fishing pressure on Indian mackerel and Indo-pacific mackerel is also thought to be unsustainable in some regions of the Philippines (Gaerlan et al., 2018; Gomez et al., 2020), and national estimates indicate that commercial landings of mackerel and squid has been in decline since at least 2012 (Figure 11)[21].

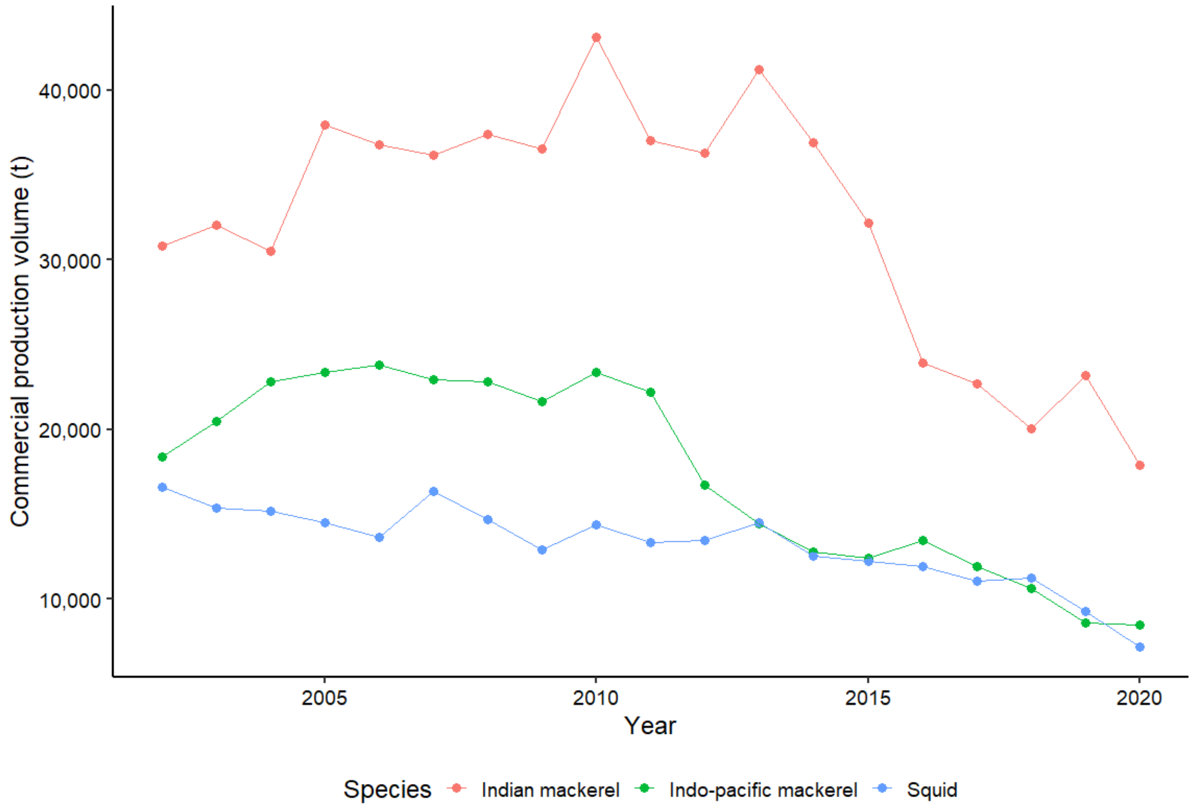

Figure 11: Commercial production volume of Indian mackerel, Indo-pacific mackerel, and squid from 2002-2020. Colours appear as per legend. Data source: PSA.

As mentioned previously, DA-BFAR implement closed seasons for small pelagic species during their peak spawning season, yet it remains unclear whether these closures are effective. Several reports suggest an increase in small pelagic catch at the end of the closure period (DA-BFAR, 2013; Mesa, 2014; Rola et al., 2018), other studies report a decrease in the municipal catch-per-unit-effort of sardines (Napata et al., 2020), and some report little to no effect on sardines but positive effects on mackerel landings (Bagsit et al., 2021). We note that none of the mentioned studies have adequately partitioned the role of environmental change and fishing pressure on the stock status of these small pelagics, ultimately meaning that the effectiveness of the closed season policy remains unclear (see Russ et al., 2021 for why considering environmental change is critical). Determining the

[21] While we acknowledge fishery landings may decline due to catch restrictions and management in developed fisheries, given weak enforcement arrangements and the high exploitation rate across most Philippine waters (with the exception of a few well-enforced marine reserves in the country; Alcala & Russ, 2002; Muallil et al., 2014), there is limited evidence that the decline of landings is due to effective fisheries management.

environmental drivers of small-pelagic stocks, the influence of fishing mortality on their biology, and the effectiveness of the closed season policy for improving stock status all remain research priorities.

At a regional scale, within the Philippines, average annual commercial production value between 2018-2020 was highest in SOCCSKSARGEN (Region XII; Figure 12), largely because this is the location of the General Santos Fish Port Complex (GSFPC), where the vast majority of skipjack, bigeye, and yellowfin tuna is landed, and the location of 6 tuna processing plants and 70% of Philippine tuna canneries. In 2019, 242,594t of total unloadings were recorded at the GSFPC alone (WCPFC, 2020). Zamboanga Peninsula (Region IX) was ranked 2nd in terms of gross commercial production value (Figure 12) and is the location where the majority of Bali sardinella is landed and at least 12 canning factories, and 25 bottled sardine processors are located (DTI, 2013, 2014). Round scad landings also contribute substantially to the gross commercial value obtained from Regions XII and IX (Figure 12). Accordingly, it is evident that the top two regions in terms of commercial fishery production value (XIII and IX) attain significant value from landings of a relatively small number of pelagic species (primarily, tuna, sardines, round scad). Conversely, the production value of commercial fisheries in the Western Visayas (Region VI; ranked 3rd for total production value in Figure 12) is spread more evenly across species with the majority (23%) of value obtained from the “Others” species category which includes a mix of demersal, pelagic, and reef associated fishes in unknown quantities. Excluding the National Capital Region (NCR), which derives substantial production value from round scad, a similar trend is evident for the remaining regions, whereby production value is spread across many species and no single species dominates commercial production value (Figure 12). This illustrates that the relative value of commercial fisheries at a regional scale may be obscured by national statistics.

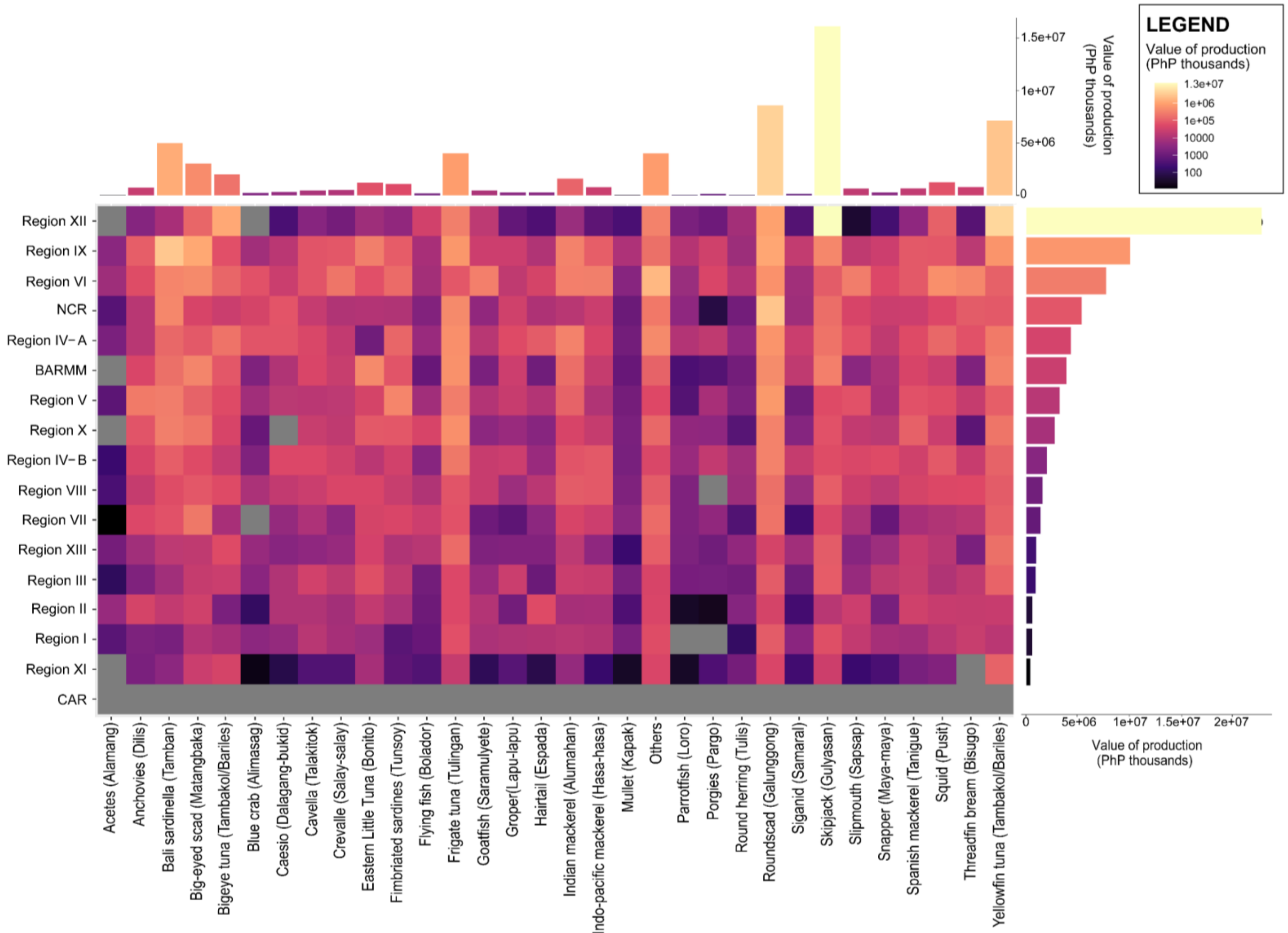

Figure 12: Heatmap of average production value of species landed by the commercial sector across all 17 regions of the Philippines between 2018 and 2020. Regions on y-axis are arranged in order of declining gross production value across species. Bar plots on top and righthand side of heatmap display the total value obtained for that particular species and region, respectively. Colours appear as per legend. Data source: PSA.

3.2.1.3 Marine Municipal Sector

Prior to discussing the most important species in terms of marine municipal production value, it is important to reiterate that national production statistics are derived primarily from port-based landed-catch monitoring and *"This means that fishers who do not land their catches in established fish ports, or those who directly sell their catches within their local community, or those who do not sell the fish at all, are not accounted for in the national statistics"* (Cabral & Geronimo, 2018). Moreover, the survey protocol only requires a minimum of five interviews to be conducted per sampling site and data is not obtained by weighing the landings. Rather information is collected based on the recall of the informant for the past month worth of landings. Not all information is collected directly from fishers - occasionally data is collected from occupations downstream of the fisher which are deemed "knowledgeable in local fishing activities"[22]. Many small-scale commercial boats are also registered as municipal vessels in the Philippines, despite often operating beyond municipal waters and using gears which would generally be considered 'industrial' (see NFRDI, 2021). All of these factors contribute to the unreliability of municipal landings data, with Palomores & Pauly (2014) estimating that cumulative municipal production may be up to 14% greater than DA-BFAR estimates. With these caveats in mind, below we discuss the top marine municipal fisheries by production value, relying upon both national statistics and independent studies on municipal catch from the peer-reviewed literature.

According to national statistics, the "Other" species category accounts for the vast majority of the production value of Philippine marine municipal fisheries (Figure 13). This category likely comprises various coral reef-associated species, coastal species (such as mullets, garfish etc.), and other small pelagic species. Following the "Others" category, the next top 10 species by average marine municipal production value comprise a mix of pelagic species (scads, tunas, mackerel, cavella), demersal fishes (threadfin bream, grouper), and two invertebrates (squid, blue crab) (Figure 13).

[22] As stated in PSA metadata for data collection during Quarterly Municipal Fisheries Surveys.

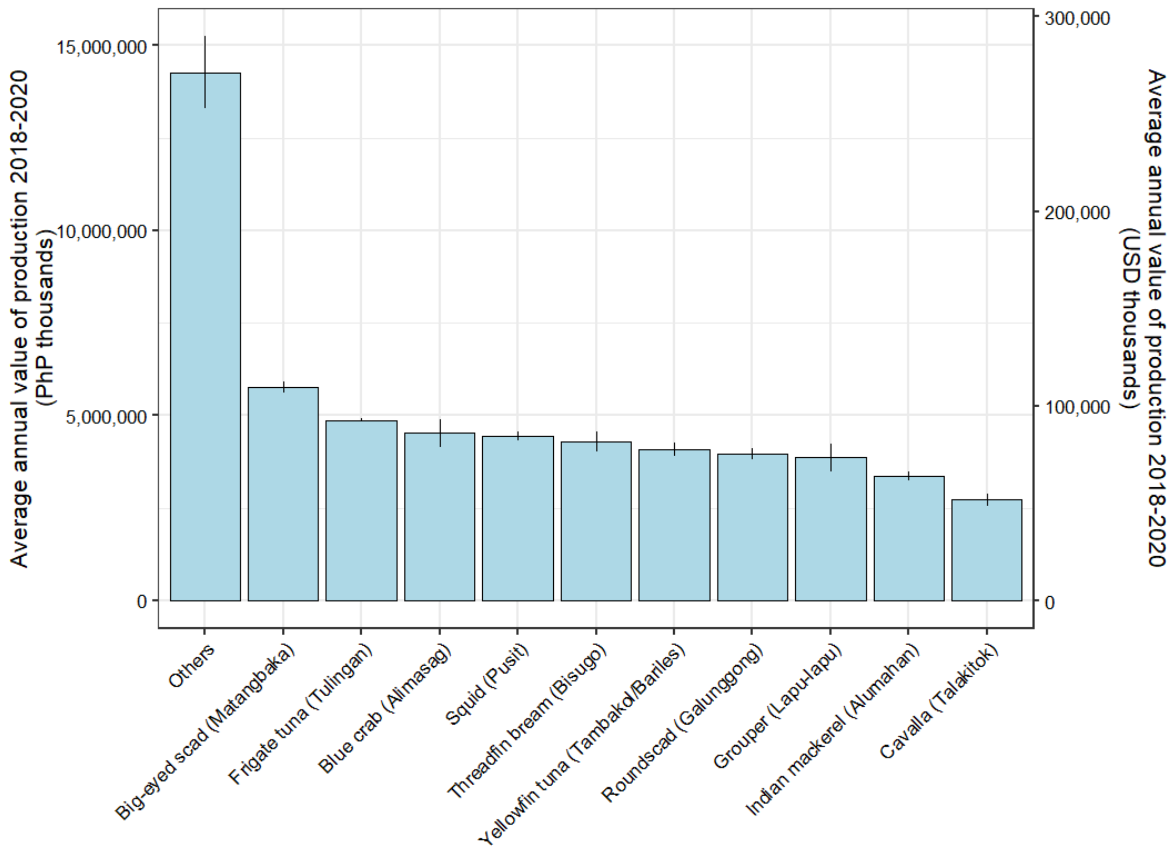

Figure 13: Top 11 most valuable species landed by the marine municipal sector, based on average gross production value between 2018 and 2020. Conversion rate at time of writing: US$1 = 52.59 PhP. Data source: PSA.

At a national level, these data are similar to that of Muallil et al., (2014), who surveyed 6,488 fishers across 44 coastal towns and municipalities in the Philippines and found that municipal catch composition was dominated by the families Carangidae (jacks and scads), Scombridae (tunas and mackerels), Siganidae (rabbitfish), Nemipteridae (breams, incl. bisugo), and "Other demersal" species.

As mentioned previously, many small commercial vessels are registered as municipal vessels in the Philippines and only purse seine, ringnet, tuna handline, and large-scale longline gears are considered "commercial" (NFRDI et al., 2021). This means that an unknown amount of municipal catch should in fact be classified small-scale commercial catch. To that end, given the marginal difference in production value of tuna and scad species in the marine municipal sector compared to the many demersal species ranked >11th in terms of production value, it is unclear whether the top 11 marine municipal species by production value should in fact comprise a greater proportion of demersal species to that indicated in Figure 13.

Data from independent studies in the peer-reviewed literature certainly suggest that a much greater proportion of municipal catch comprises demersal species compared to that indicated in national statistics (Figure 14). PSA data indicates that between 2018 and 2020, ≈15% of marine municipal production value was obtained through catch of demersal species[23] across regions, which rises to ≈28% if we assume the "Other species" category comprises 70% demersal species. While not nationwide in coverage, this estimate is similar to the 31.3% contribution of reef-associated fishes to total harvest in the Central Philippines (Bacalso & Wolff, 2014). Conversely, Muallil et al., (2014), showed that 54% of municipal catch composition comprised demersal species across 44 coastal towns and municipalities in the Philippines. Similarly, Lavides et al., (2016) surveyed 2,655 fishers across 61 villages of the Philippines, concluding that reef-associated fishes comprised approximately 76% of catch composition (52–94% depending on location).

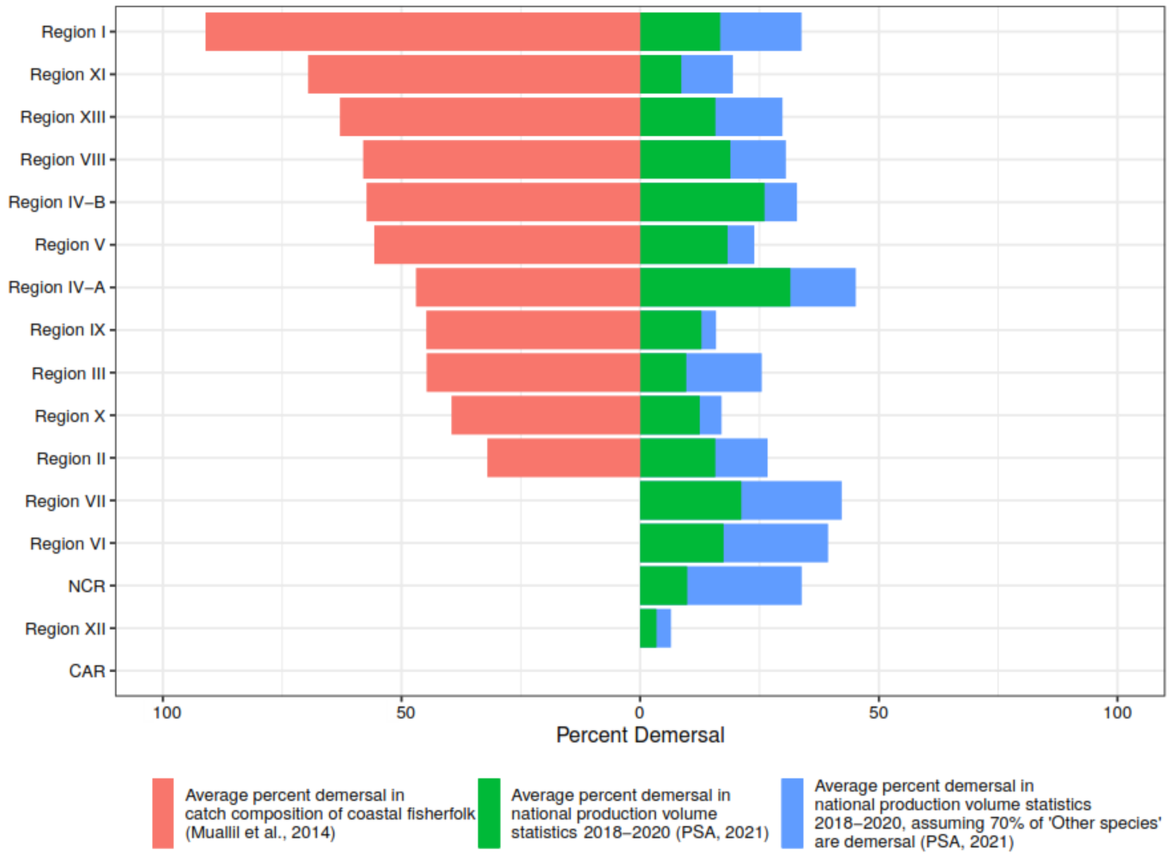

Figure 14: Comparing the prevalence of demersal fishes in municipal catches according to independent studies (Muallil et al., 2014; orange bars) and national fish production data (PSA data; green and blue bars). Regions are arranged in order of declining demersal catch composition according to Muallil et al., 2014.

It is likely that the true contribution of demersal species to production volume and value lies between national and independent estimates for two reasons: 1) Muallil et al., (2014) may have overestimated demersal catches by categorising total catches based on the dominant species caught by each interviewed fisher; and 2) Muallil et al., (2014) and Lavides et al., (2016) generally surveyed fishers in remote locations where demersal stocks are not as overexploited as they are adjacent to urban centres, which comprise a greater proportion of locations surveyed by PSA (e.g., see Verde Island Passage vs. Polillo Islands in Lavides et al., 2016; Panabo city vs. Samal city in Muallil et al., 2014). These independent studies provide insight as to the importance of demersal fishes in

[23] Demersal species include both reef-associated (e.g., Labridae (wrasses and parrotfish), Lethrinidae (emperors), Mullidae (goatfish), Serranidae (groupers), Lutjanidae (snappers), Acanthuridae (surgeonfish)) and non-reef-associated species (e.g., Nemipteridae (threadfin breams), Leiognathidae (slipmouths))

municipal catches, particularly in remote locations away from urban centres where reef-fish and demersal stocks are less overexploited.

Blue crab (ranked 4th) was not a top species in the catch composition of municipal fishers surveyed by Muallil et al., (2014) and national statistics indicate highly variable production volume through time (Figure 15b). Despite this, the value of blue crab production in the municipal sector has increased substantially in recent years (Figure 15a) and a recent report on the Blue Crab Fishery noted that traders, processors, and exporters have experienced limited supply due to the increasing demand for crabs by the burgeoning population and export industry (Yap et al., 2020). Meanwhile, evidence suggests that some blue crab stocks have been declining since the 1990s and continue to be overfished, particularly in the Western Visayas Sea (Mesa et al., 2018). Thus, while this species certainly contributes to the current production value of municipal fisheries, the degree to which production volume can sustainably increase to meet market demand remains unclear. In select sites of Danajon Bank, the Philippine Association of Crab Processors, Inc. (PACPI) and BFAR-7 have run a stock enhancement program for blue crabs since 2017, which theoretically may enable increased production, but at this point in time the effectiveness of this program remains unclear (Abrenica et al., 2021).

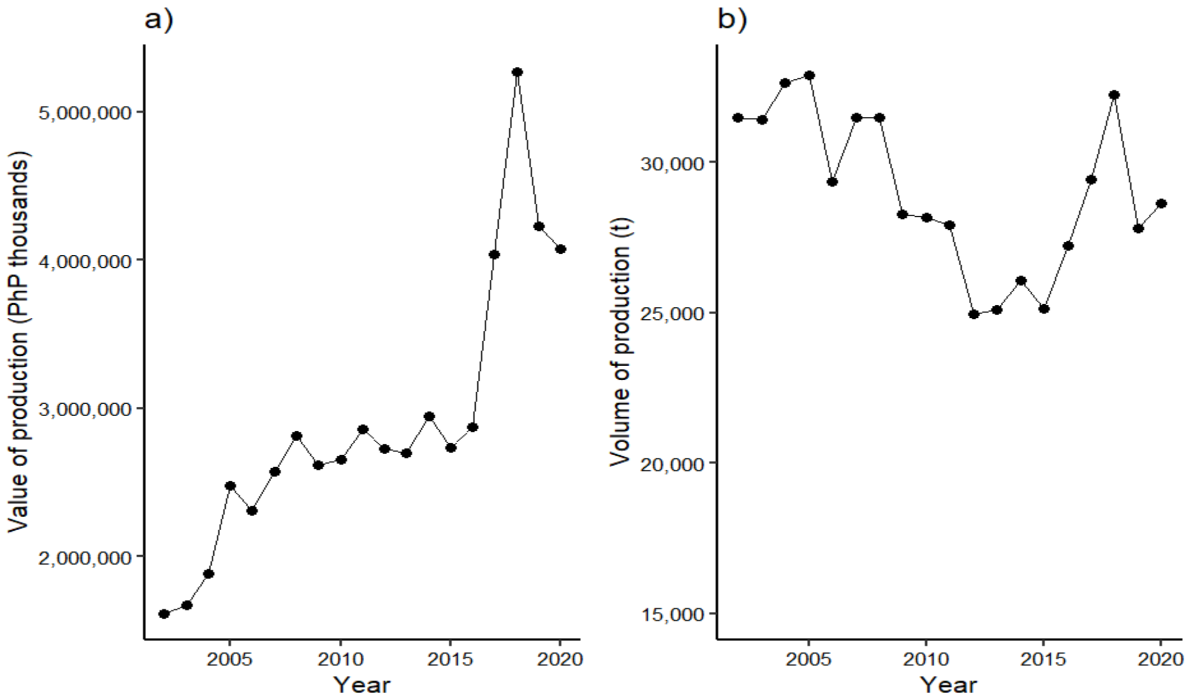

Figure 15: Temporal trends (2002-2020) in the value (a) and volume (b) of blue crab production attributed to the municipal sector. Data source: PSA.

Information on catch, distribution, and stock status of species within the squid (ranked 5th) taxonomic group are limited. Evidence suggests there are four genera and seven species of the squid species in the Philippines with *Sepioteuthis lessoniana* the most common and generally targeted by trawl and bagnet gears (Hernando & Flores, 1981). Despite bagnets often being used beyond municipal waters (e.g., Balisco, 2019), landings from these gears are attributed to the municipal sector for statistical purposes (NFRDI, 2021). Trawl gears are not covered by NFRDI (2021) and thus it is unclear whether squid caught via trawl is also classified as municipal catch in national statistics. Nevertheless, it is evident that an unknown proportion of gross squid production value for the municipal sector should be attributed to small commercial vessels using bagnets (and possibly trawl) in commercial waters. While we acknowledge that some municipal fishers target squid using jigs (Balisco, 2019; Hernando & Flores, 1981), in our experience many species ranked lower than squid in terms of production value are often more prevalent in municipal catches and markets.

The remaining demersal fishes (i.e., threadfin bream, grouper; Figure 13) are common in wet markets throughout the Philippines. These species are not heavily targeted by commercial sector, and thus play an important role in supporting livelihoods of municipal fishers. While little is known regarding the species composition of these taxonomic groups and consequently stock status trends are unclear, studies indicate that several species within these taxonomic groups are overexploited (Muallil et al., 2014; Lavides et al., 2016). There remains a need to collect better catch and biological data on species within these taxonomic groups and, in turn, assess the status of heavily targeted stocks.

At a regional scale, within the Philippines, marine municipal production value was highest in MIMAROPA (Region IV-B), which accounted for 13% of gross marine municipal production value (Figure 16). The Bicol and Western Visayas regions (Region V and VI, respectively) were ranked 2nd and 3rd in terms of production value, accounting for 11.6% and 11.4% of gross marine municipal production value between 2018 and 2020, respectively (Figure 16). Unlike the commercial sector, municipal production value is more evenly distributed across regions and species, with demersal species comprising greater relative value in the municipal sector (Figure 16). This likely reflects the generalist nature of fishing gears and inshore location of fishing effort (<15 km from coastline).

It is worth clarifying that, although municipal and commercial sectors are purported to be separated by spatial boundaries, they are in fact in direct competition over the same targeted stocks. This is exemplified by the fact that big-eyed scad, yellowfin tuna, frigate tuna, round scad, and bigeye tuna appear in the top 11 species by production value for both sectors. These pelagic species have wide stock boundaries that encompass adjacent regions (if not Philippine waters and beyond). Accordingly, any differences in regional production value likely reflect areas where these stocks are accessible within municipal waters, differences in the geographic location of municipal and commercial landing sites and ports, and/or differences in the vessels and gears used rather than the targeting of separate stocks. For this reason, increases in commercial catch of species such as big-eye scad could result in a decline in municipal catch of this species and vice-versa, particularly in Zamboanga Peninsula (Region IX) where both sectors attain most of the production value from this species.

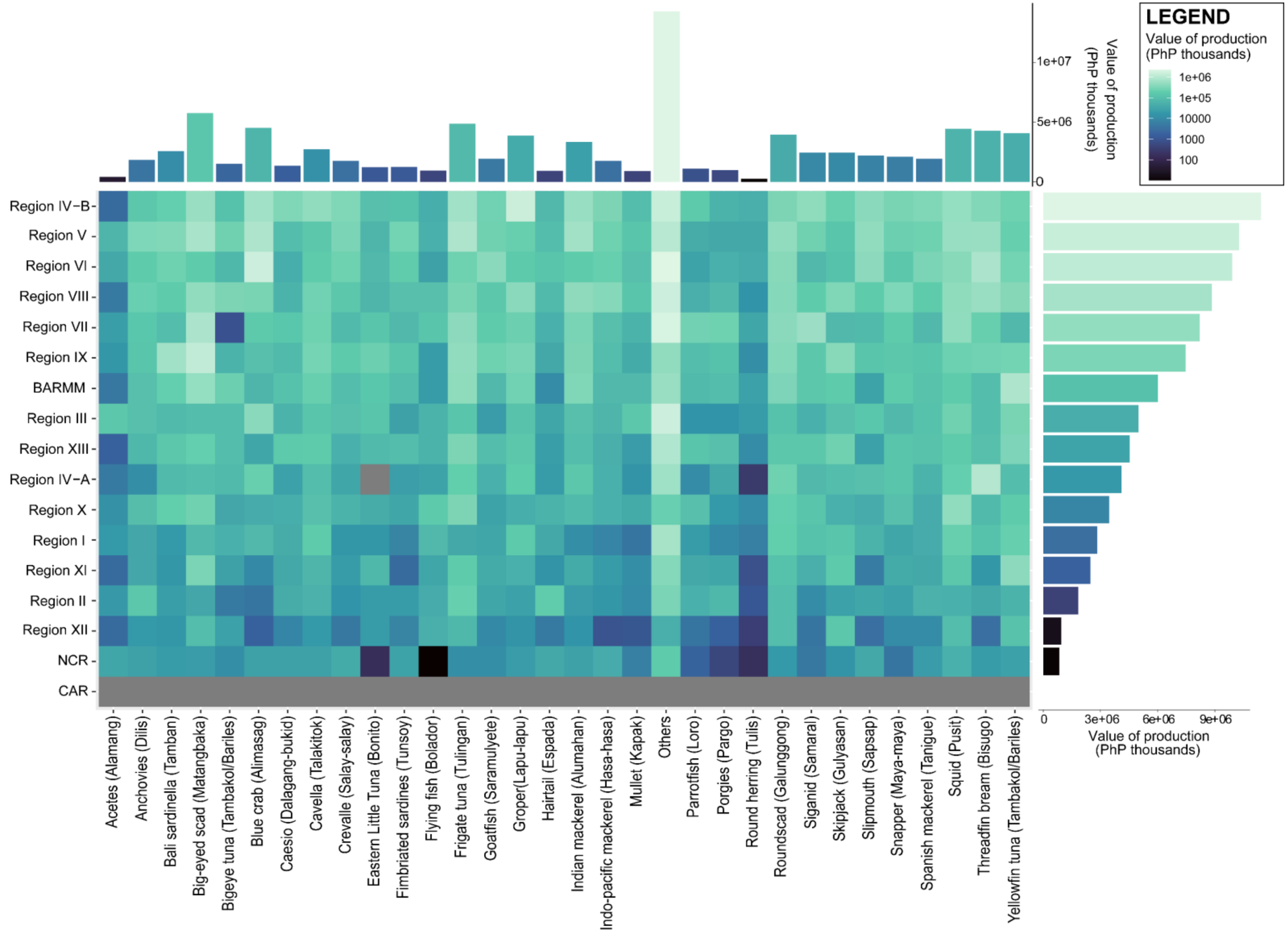

Figure 16: Heatmap of average production value of species landed by the marine municipal sector across all 17 regions of the Philippines between 2018 and 2020. Regions on y-axis are arranged in order of declining gross production value across species. Bar plots on top and righthand side of heatmap display the total value obtained for that particular species and region, respectively. Colours appear as per legend. Data source: PSA.

3.2.1.4 Inland municipal

Other than data provided by the Philippines Statistics Authority on production value and volume, there have been very few independent studies on inland municipal fisheries in the Philippines. This may stem from the fact the inland municipal sector contributes relatively little to total production volume and value relative to other sectors of the Philippine fishing industry. Nevertheless, while the contribution of inland municipal fisheries to GDP and overall employment is low, these fisheries provide important livelihood opportunities and a source of fish protein to rural communities. Below we review the available data on this fishery sector but note that there is far less information on target species and almost no recent information on stock status compared to other fishery sectors. This remains a knowledge gap in our understanding of Philippine fishery resources.

If we were to exclude the "Other fishes" category (ranked 8th), the top 10 taxonomic groups by total inland municipal production value comprise a variety of fishes (tilapia, carp, mudfish, milkfish, catfish, freshwater goby, eel) and invertebrates (freshwater shrimp, mud crab, lobster) (Figure 17).

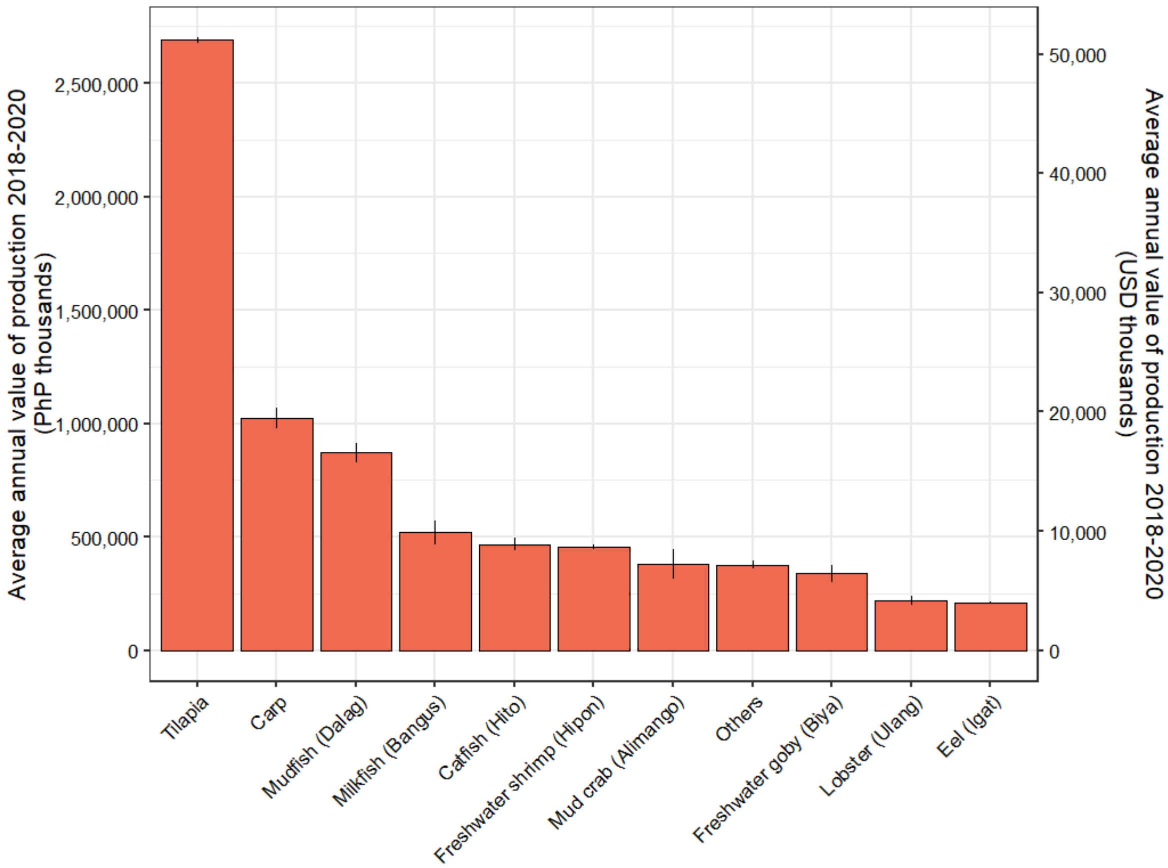

Figure 17: Top 11 most valuable species landed by the inland municipal sector, based on average gross production value between 2018 and 2020. Conversion rate at time of writing: US$1 = 52.59 PhP. Data source: PSA.

Tilapia is by far the most valuable species, on average worth 2.6 times as much as carp from 2018-2020 which was ranked 2nd in terms of production value (Figure 17). Tilapia production from inland fisheries has been stable through time and is supported by the stocking of fingerlings through DA-BFAR's National Inland Fisheries Technology Center Program on the Fisheries Enhancement of Inland Waters, known as "Balik Sigla sa Ilog at Lawa" (BASIL). Along with tilapia, DA-BFAR's BASIL program also stocks carp (ranked 2nd in Figure 17) and other indigenous species (e.g., mudfish, ranked 3rd in Figure 17) into inland waters, with around 153 million fingerlings stocked in recent years (Table 5).

Table 5: Present status of DA-BFAR's BASIL program as of December 2020.

Management Areas	No. of Beneficiaries	No. of Management Areas	No. of Fingerlings Stocked	Fish Production in Metric Tons	Status
Lakes, Rivers and Reservoirs	3,169 (included the Indigenous people in some upland and landlocked areas in Luzon, Visayas and Mindanao	127	Carps, Tilapia and Indigenous fishes = 76,629,872 Pieces	11,027.61 Metric Tons	Enhanced Management Areas
	Fisherfolk Beneficiaries (2017) = 788 Common People = 652 Indigenous people = 136	2017 = 44	2017 = 12,170,000 Pieces	2017 = 527 Metric Tons	
	Fisherfolk Beneficiaries (2018) = 527 Common People = 407 Indigenous people = 120	2018 = 17	2018 = 19,550,000 Pieces	2018 = 2,690 Metric Tons	
	Fisherfolk Beneficiaries (2019) = 1,458 Common People = 1,458	2019 = 60	2019 = 25,594,286 Pieces	2019 = 1,839.76 Metric Tons	
	Fisherfolk Beneficiaries (2020) = 396 Common People = 396	2020 = 60	2020 = 19,103,367 Pieces	2020 = 5,970.85 Metric Tons	

Source: https://www.bfar.da.gov.ph/index.php/coastal-resource-management/basil/

The BASIL Program also aims to rehabilitate/restore the physical conditions of minor lakes and reservoirs; enhance the fisheries; and repopulate indigenous species in support of biodiversity conservation, poverty alleviation, and food sufficiency. These efforts have likely supported inland production of tilapia, carp, and mudfish through time (ranked 1st, 2nd, 3rd in Figure 17, respectively).

Milkfish (ranked 4th) caught by the inland municipal sector contributes only a small proportion of annual total milkfish production (1.25% on average between 2000 and 2019), with the vast majority coming from aquaculture production (Salayo et al., 2021). Milkfish caught by inland municipal fishers are likely escapees from culture pens and cages within lakes and other freshwater water bodies (Salayo et al., 2021).

At a regional scale, BARMM, Central Luzon (Region III), and Calabarzon (Region IV-A) were the top 3 regions by average production value between 2018 and 2020, contributing 23.5%, 16.7%, and 12.7% of gross production value, respectively (Figure 18). BARMM derived significant value from the four most valuable inland municipal target species (tilapia, mudfish, milkfish, carp), while production value in Central Luzon (Region III, ranked 2nd) was spread more evenly across species (Figure 18). Calabarzon (Region IV-A) relied heavily on tilapia, as did SOCCSKSARGEN (Region XII, ranked 4th), along with catches of mudfish (Figure 18).

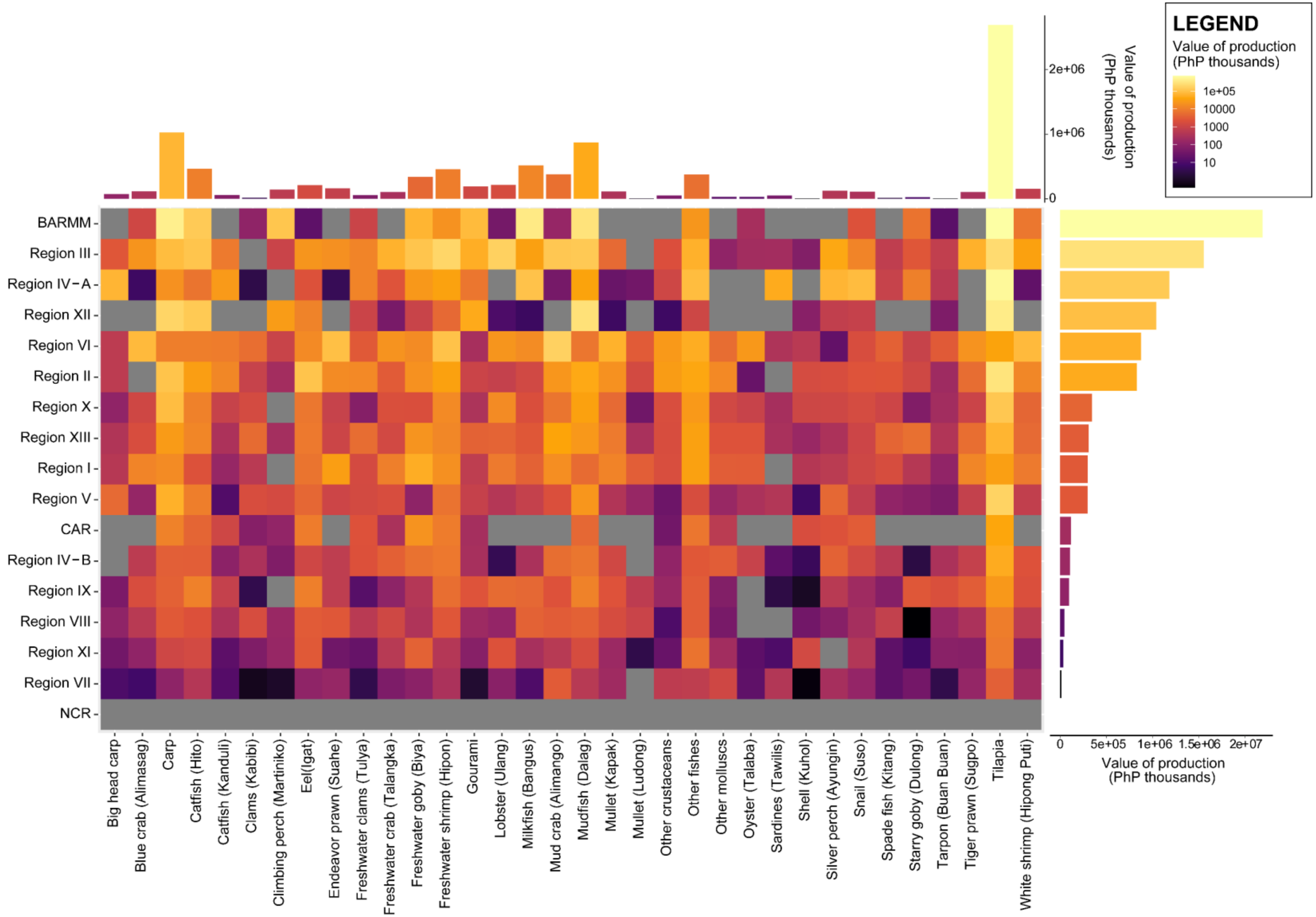

Figure 18: Heatmap of average production value of species landed by the inland municipal sector across all 17 regions of the Philippines between 2018 and 2020. Regions on y-axis are arranged in order of declining gross production value across species. Bar plots on top and righthand side of heatmap display the total value obtained for that particular species and region, respectively. Colours appear as per legend. Data source: PSA.

3.2.1.5 Aquaculture Sector

Across culture environments, the top species by average annual production value between 2018 and 2020 were milkfish, tilapia, tiger prawn, seaweed, mud crab, and the “Other” species group, with comparatively little value obtained from the culture of the remaining five taxonomic groups (oyster, catfish, mussel, white shrimp, carp; Figure 19).

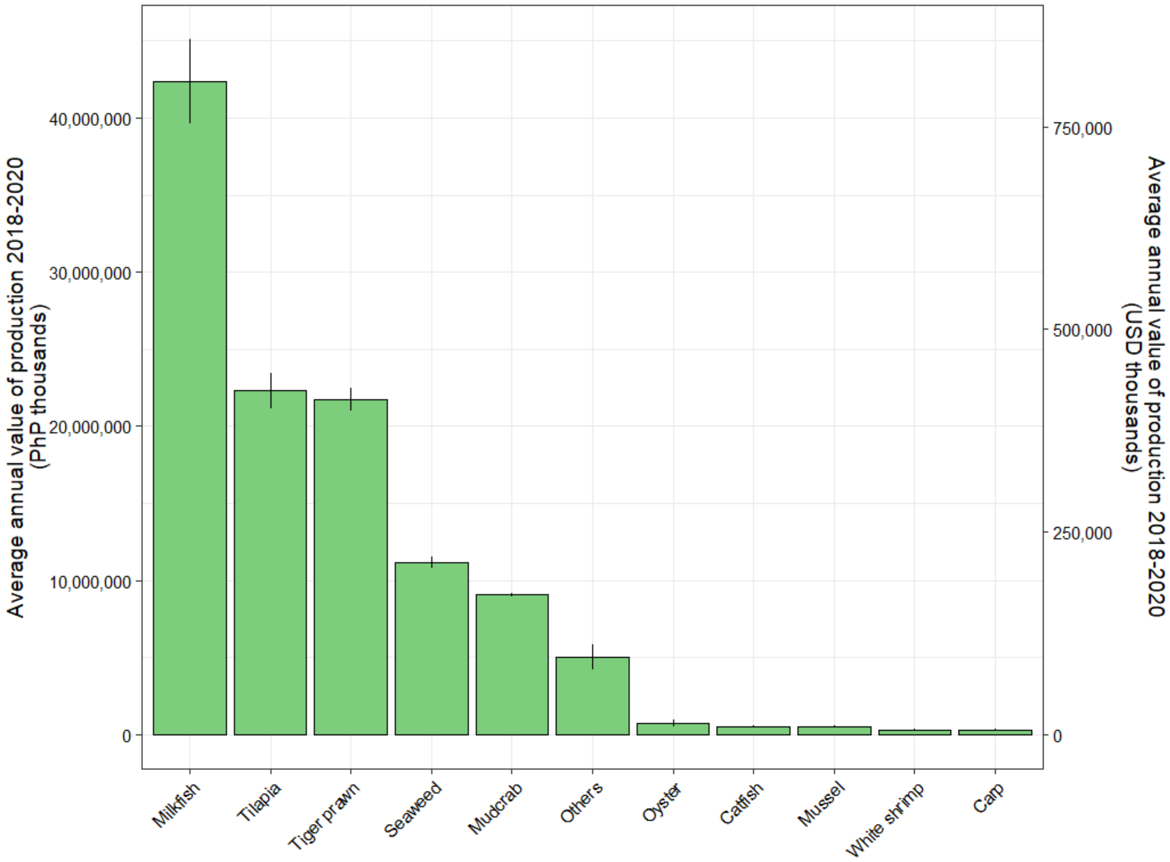

Figure 19: Top 11 most valuable species landed by the aquaculture sector, based on average gross production value between 2018 and 2020. Conversion rate at time of writing: US$1 = 52.59 PhP. Data source: PSA.

Milkfish has long been the backbone of Philippine aquaculture production and remains the most valuable aquaculture species in terms of total production value and volume, most of which is produced in brackish water fishponds and marine cages (Figure 20). Improvements in culture techniques, diversification of culture environments, development of mariculture parks by DA-BFAR, and emergent investments from financially capable farmers has resulted in the substantial growth in the production of milkfish over the past 20 years (Salayo et al., 2021). Similarly, production value increased annually at a rate of 7.31% on average from 11.84 billion PhP in 2000 to 43.35 billion PhP in 2019 (Salayo et al., 2021).

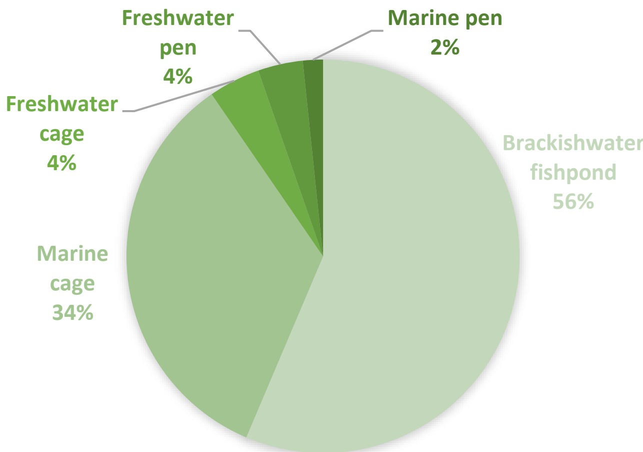

Figure 20: Relative contribution of the various culture environments for milkfish, in terms of average production value obtained from 2018-2020. Data source: PSA

A major limiting factor to milkfish production in the Philippines in the importation of fry, mainly from Indonesia and Taiwan, to augment the seed requirements of the grow-out industry (Ahmed, 2001; Ferrer et al., 2016; Sugama, 2007; Salayo et al., 2021). It is estimated that the Philippines milkfish industry requires around 1.5 billion fry annually (1.493 billion in 2019; Salayo et al., 2021, 1.65 billion; Ahmed, 2001). While the number of integrated breeding and hatchery facilities have increased through time, substantial investment will be required if adequate fry production is to be undertaken domestically in future years. Indeed, domestic production of sufficient fry supply was one of the major goals in DA-BFAR's Comprehensive National Fisheries Industry Development Plan 2016–2020 and remains critical to achieve increased milkfish production to sustain the Philippines growing population (Salayo et al., 2021).

Tilapia is the second most important cultured fish in the Philippines and is primarily produced in freshwater fishponds and freshwater cages (Figure 21). In 2018, the Philippines ranked 6th in the world in terms of tilapia production volume (Miao & Wang, 2020). While milkfish is an indigenous species, the Mozambique tilapia (*Oreochromis mossambicus*) was introduced to the Philippines in 1950 from Thailand, followed by the Nile tilapia (*O. niloticus*) in 1972, and other species thereafter (*O. aureus, O. hornorum, Coptodon zillii,* and *Sarotherodon melanotheron*) (Asian Development Bank, 2004). As an introduced species, massive aquaculture of Tilapia in various lakes in the country, including the Laguna Lake, has severely affected the populations of native species to the point of local extinction.

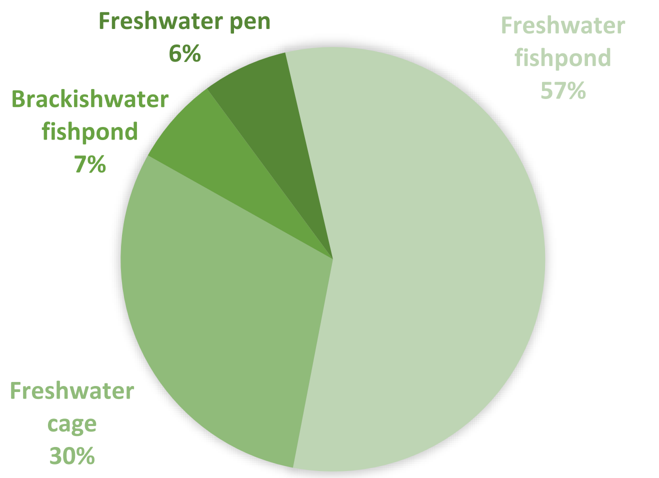

Figure 21: Relative contribution of the various culture environments for tilapia, in terms of average production value obtained from 2018-2020. Data source: PSA

Tilapia production is dependent on fry from domestic hatcheries and DA-BFAR has supported numerous advances in selective breeding and genetic improvement of tilapia in recent years, including the development of several tilapia strains and hybrids (e.g., *Molobicus* and BEST) that are saline-tolerant (Guerrero, 2019). Nevertheless, after a boom in tilapia production during the early 2000s, attributed to formulated diets and improved strains of Nile tilapia (Romana-Eguia et al., 2013), annual increases in production volume have slowed, and remain well below that projected in DA-BFAR's Road Map for the Tilapia Industry (2014–2016) (Guerrero, 2019). In fact, based on PSA data there was no increase in tilapia production between 2014 and 2016. Guerrero (2019) conducted focus group discussions and key informant interviews with 55 tilapia farmers (pond, cage, pen, and hatchery operators) from Luzon and Mindanao, who perceived that the primary factors impacting tilapia production in recent years were "High Water Temperature" (68%), "Lack of Government Assistance" (58%), "Poor Breed of Tilapia" (48%), "High Cost of Production" (46%), and "Lack of Capital" (44%).

Tiger prawns were ranked 3rd in terms of total production value in the aquaculture sector and are primarily produced in brackish water fishponds (>99% 2018-2020; PSA data). Philippine tiger prawn culture expanded substantially during the 1980s as many farmers switched from traditional extensive culture to intensive shrimp monoculture. However, lucrative returns from farmed prawn exports and the consequent expansion of prawn aquaculture soon led to massive destruction of the country's mangrove forests, resulting in a number of social, economic, and food security issues for coastal communities (Palanca-Tan, 2018). Up until 1994, high foreign demand and market prices led to significant investment in hatchery and grow-out operations, further increasing production, however disease outbreaks in the mid 1990s soon caused an abrupt decline in production (Palanca-Tan, 2018). Production since then has remained relatively stable at around 42,000t annually (PSA data) and tiger prawns remain a high value species raised mainly for export. Nevertheless, tiger prawn production appears relatively inefficient. In 2019, 15,068t of prawn feeds worth 829 billion PhP (US$15.97 million) were imported to the Philippines, primarily from Vietnam (93% of volume), while 6,544t of “shrimp/prawn” was exported during 2019 worth 1.56 billion PhP (US$42.365 million) (DA-BFAR, 2020a).

Seaweed was ranked 4th in terms of average annual production value and is presently one of the most productive mariculture activities undertaken in the Philippines, with more than 60,000 ha of reef and shallow coastal areas being utilized (Trono & Largo, 2019). The Philippines produced 1,499,961.25t of seaweeds in 2019 alone, which translates to 63.6% of total aquaculture production by volume (DA-BFAR, 2020a). Trono & Largo (2019) provide a good overview of seaweed culture in the Philippines, but briefly seaweeds can be used for several applications, including for food, biofuels, bioremediation, bio-stimulants, cosmetics, nutraceuticals, and pharmaceuticals. Historically, the Philippines was the world leader in the production of eucheumatoid seaweeds, but production has diversified in recent years with many species of seaweed now contributing to the national economy and food consumption (Table 6). Aside from seaweed being a popular food domestically, seaweeds are also an important export commodity for the Philippines (Trono & Largo, 2019), with the industry second only to the tuna industry in terms of both export volume and value (DA-BFAR, 2020a). The limiting factor currently affecting the seaweed industry is outbreaks of diseases and pests (Critchley et al., 2004; Vairappan et al., 2008; Mateo et al., 2020).

Table 6: Seaweed species utilized as food. Source: Trono & Largo, 2019.

Brown algae	Green algae	Red algae
Hydroclathrus clathratus (C.Agardh) M.Howe	*Monostroma nitidum* Wittrock	*Porphyra marcosii* P.A.Cordero
Rosenvingea intricata (J.Agardh) Børgesen	*Ulva lactuca* Linnaeus	*Pyropia suborbiculata* (Kjellman) J.E.Sutherland, H.G.Choi, M.S.Hwang & W.A.Nelson
Hormophysa triquetra (C.Agardh) Kützing	*Enteromorpha compressa* (Linnaeus) Nees	*Trichogloea requienii* (Montagne) Kützing
Sargassum confusum C.Agardh	*Chaetomorpha aerea* (Dillwyn) Kützing	*Scinaia hormoides* Setchell
Sargassum gracillimum Reinbold	*Cladophora rugulosa* G.Martens	*Gelidiella acerosa* (Forsskål) Feldmann & Hamel
Sargassum hemiphyllum (Turner) C.Agardh	*Cladophora rupestris* (Linnaeus) Kützing	*Halymenia dilatata* Zanardini
Sargassum ilicifolium (Turner) C.Agardh	*Caulerpa lentillifera* J.Agardh	*Halymenia durvillei* Bory
Sargassum kushimotense Yendo	*Caulerpa chemnitzia* (Esper) J.V.Lamouroux	*Halymenia harveyana* J.Agardh
Turbinaria ornata (Turner) J.Agardh	*Caulerpa racemosa* (Forsskål) J.Agardh	*Halymenia maculata* J.Agardh
Turbinaria conoides (J.Agardh) Kützing	*Caulerpa sertularioides* (S.G.Gmelin) M.Howe	*Callophyllis* Kützing
	Caulerpa taxifolia (M.Vahl) C.Agardh	*Titanophora weberae* Børgesen
	Codium edule P.C.Silva	*Gracilaria arcuata* Zanardini
	Codium repens P.Crouan & H.Crouan	*Gracilaria blodgettii* Harvey
		Gracilaria incurvata Okamura
		Gracilaria salicornia (C.Agardh) E.Y.Dawson
		Gracilaria textorii (Suringar) Hariot
		Gracilaria coronopifolia J.Agardh
		Hydropuntia eucheumatoides (Harvey) Gurgel & Fredericq s
		Crassiphycus firmus (C.F.Chang & B.-M.Xia) Gurgel, J.N.Norris & Fredericq
		Eucheuma arnoldii Weber Bosse
		Eucheuma denticulatum (N.L.Burman) Collins & Hervey
		Kappaphycus alvarezii (Doty) Doty ex P.C.Silva
		Kappaphycus cottonii (Weber Bosse) Doty ex P.C.Silva
		Kappaphycus striatus (F.Schmitz) Doty ex P.C.Silva
		Betaphycus gelatinus (Esper) Doty ex P.C.Silva
		Hypnea charoides J.V.Lamouroux
		Hypnea pannosa J.Agardh
		Calliblepharis saidana (Holmes) M.Y.Yang & M.S.Kim
		Acanthophora spicifera
		Laurencia composita Yamada
		Laurencia pinnata
		Chondrophycus intermedius (Yamada) Garbary & J.T.Harper
		Chondrophycus undulatus (Yamada) Garbary & Harper
		Palisada perforata (Bory) K.W.Nam
		Gymnogongrus C. Martius

The species of *Caulerpa*, *Codium*, *Euchema*, *Kappaphycus*, *Gelidiella*, *Gracilaria* and *Porphyra* are the most commonly used for human consumption. Source: Trono 1997, Montaño et al. 2015.

At a regional scale within the Philippines, the value derived from aquaculture production is highest in Central Luzon (Region III; 31% of production value between 2018-2020), the location of the majority of tiger prawn production, as well as substantial production of milkfish, mud crabs, and oysters (Figure 22). Ilocos (Region I) was ranked 2nd and contributed 14% of gross production value between 2018 and 2020, primarily deriving value from milkfish production in marine cages and pens (Figure 22). Calabarzon (Region IV-A) contributed 11.8% of gross aquaculture production value and was ranked 3rd, deriving substantial value from tilapia production in freshwater cages (Figure 22).

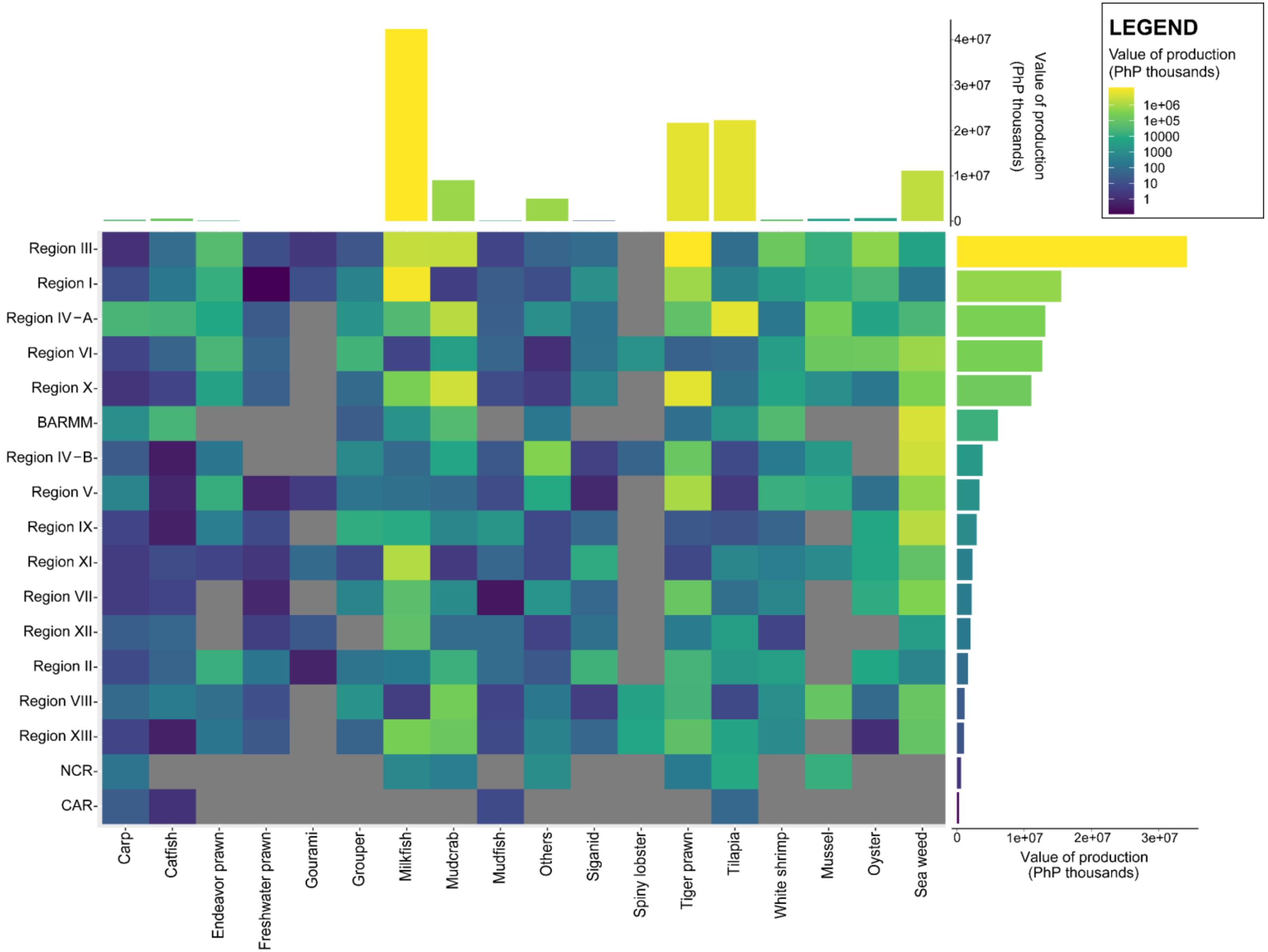

Figure 22: Heatmap of average production value of species cultured by the aquaculture sector across all 17 regions of the Philippines between 2018 and 2020. Regions on y-axis are arranged in order of declining gross production value across species. Bar plots on top and righthand side of heatmap display the total value obtained for that particular species and region, respectively. Colours appear as per legend. Data source: PSA.

3.2.2 Per employee income

While the gross production value provides a means to examine which sectors, target species, and regions are important for the national economy, per employee income provides an insight to the socio-economic benefit to Filipino workers from fishing and fish-related activities. Below we discuss the approximate per employee incomes of major actors involved in the typical value chain of each fisheries sector and identify data gaps in our understanding of per employee income. These data were obtained from a substantial search of the published literature. Generally, we did not include average income estimates from the PSA *Annual Survey of Philippine Business and Industry* (ASPBI) as these estimates were not disaggregated by role (i.e., fish worker, boat owner etc.) and thus would not provide an accurate picture of the 'real' income per employee. To provide the most relevant income information for each sector, we only considered income estimates published within the past 10 years (2012 – 2022).

3.2.2.1 Commercial Sector

Wages of vessel owners, operators, and fishers in the Philippine commercial fishing industry, including the tuna handlining sector, are subject to minimum daily rates set by the Department of Labour and Employment (DOLE). Specifically, Department Order No. 156-16 (DO-156) establishes labour standards, occupational health and safety requirements, minimum wage, holiday and premium pay, paid service incentive leave, and 13th month pay for the fishing industry (since amended by Department Order 196 in 2018).

However, there has been strong opposition to DO-156 from some operators (IUF, 2017) and evidence suggests that these basic regulations are not always complied with. For example, interviews conducted by Verite (2020) with fishers in the commercial tuna handline sector revealed that no medical screening, formal training, or orientation was undertaken, and most fishers had no knowledge of their basic labour rights, formal health and safety requirements, or relevant legal frameworks such as DO-156, although they have been engaged in handline fishing for many years. Similarly, interviews by WINFISH (2018) suggest that the minimum wage was only paid to only about 36% of workers in tuna value-added processors in General Santos, while around 80% of respondents in canneries said they were being paid the minimum wage. A subsequent study by Prieto-Carolino et al., (2021) found that women in canneries of General Santos earnt less than men, with 90% of women interviewed earning less than 15,000 PhP per month, while 50% of men interviewed earnt >15,001 PhP per month. While men and women are known to perform different roles within canneries and factors such as experience, education, and training presumably intersect to influence wages, inequitable income between men and women cannery workers certainly requires further investigation (Prieto-Carolino et al., 2021). Conversely, in frozen processing operations of General Santos, all those interviewed claimed to be given the minimum wage (WINFISH, 2018; Prieto-Carolino et al., 2021).

While DOLE conducts joint inspection trainings on DO-156 standards and trained inspectors have conducted some audits of the commercial fishing sector, primarily in land-based facilities, Verite (2020) report that by September 2020 no handline vessel owners or employers had received infringements for non-compliance with said regulations.

Due to the various forms in which commercial fisher and fish worker incomes were reported in the literature (e.g., annual, monthly, daily) and the largely unknown number of days worked per year by each fisher or fish worker, we standardised gross incomes of commercial fish workers reported in the peer-reviewed literature, assuming each tuna worker/ fisher was engaged 5 days per week for the entire year and each sardine worker/ fisher was engaged 5 days per week for the 9 month open season (Figure 23). This could be seen as an overestimate in some cases (e.g., tuna vessel owners) and a reasonable approximation in others (e.g., cannery workers). Estimates plotted below in Figure 23 would certainly benefit from better data on the number of days employees in the commercial sector work per year and more published estimates on per employee income, particularly for fishers.

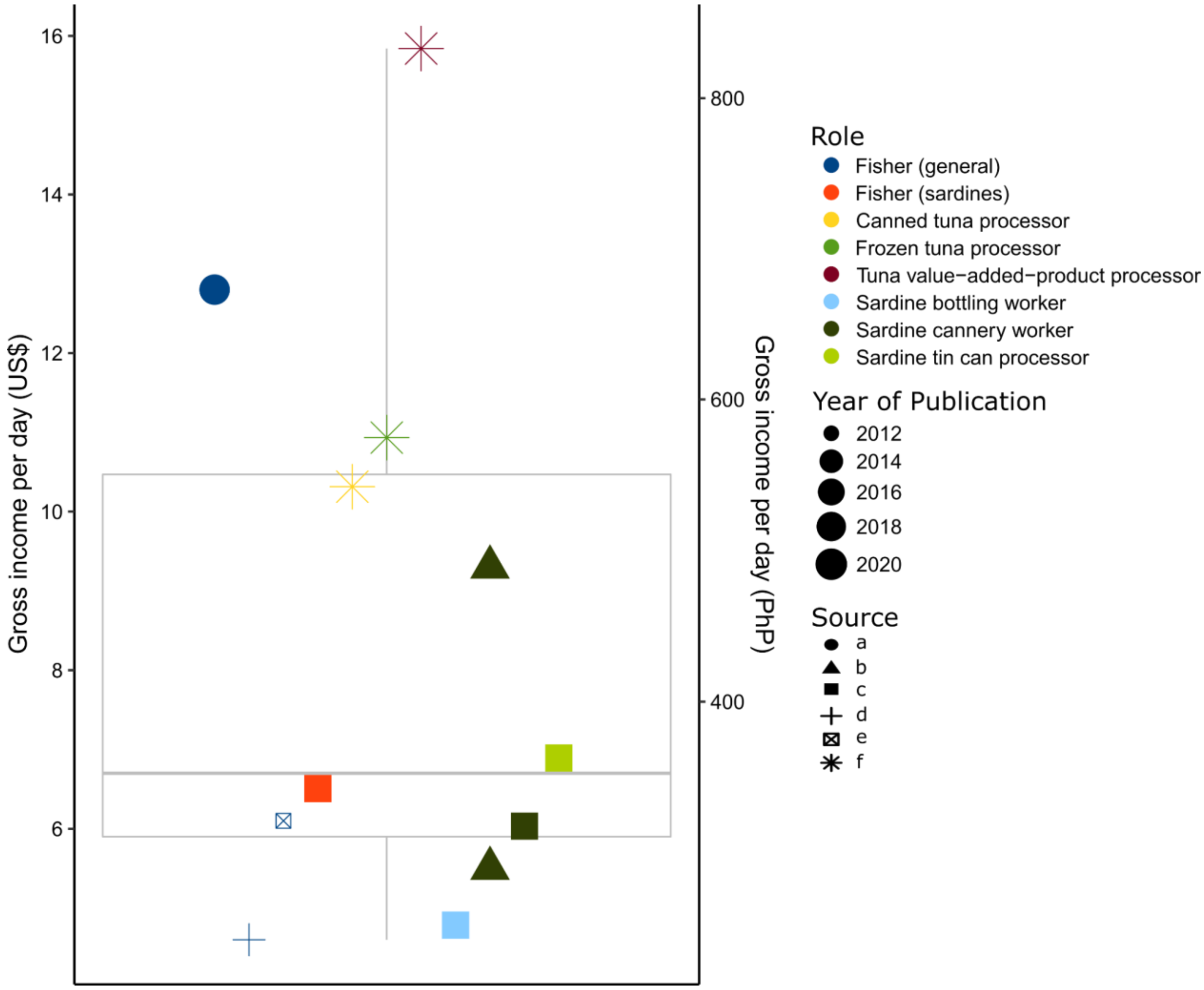

Figure 23: Gross income of commercial fishers reported in the peer reviewed literature. Sources: a) Gekara & Sampson (2020), b) Brillo et al., (2019), c)Narvaez (2017), d) Corpuz (2014), e) WCPFC WPEA OFMP (2012), f) Prieto-Carolino et al., (2021). Individual datapoints represent location-specific income estimates.

In addition to domestic jobs, many Filipinos work as commercial fishers or seafarers on boats which operate in foreign waters or the high seas. Our experience is that Filipino fishers earn around US$450 per month on purse seine boats within the WCPO. Filipino crew are typically hired through local recruitment agencies who are in turn engaged by local and foreign fishing companies to supply crew. Recruitment agencies supplying crew to foreign vessels are licensed through the Philippines Overseas Employment Administration.

While seafaring provides a valuable employment opportunity for Filipinos, unfortunately exploitation of Filipino fishermen aboard commercial fishing vessels registered in Taiwan, South Korea, Singapore, New Zealand, the UK, and many others have been previously documented (Couper et al., 2015; Howard, 2012; Yea, 2014). In response to increasing public and market scrutiny of labour conditions on fishing vessels in recent years, many management authorities and larger fishing companies are implementing new programs to demonstrate fair and respectful pay and working conditions for crew. In the WCPO for example, WCPFC members are currently in discussions to develop a new, binding conservation and management measure (CMM) on crew labour standards to strengthen its existing non-binding and relatively 'high level' Resolution on Labour Standards for Crew on Fishing Vessels (Resolution 2018-01) [24]. Amongst the private sector, companies such as Thai Union have implemented new social accountability programs[25], while initiatives such as the Seafood Taskforce are aiming to develop broad-based coalitions to strengthen labour standards across a number of sectors including shrimp and tuna[26].

As described above in section 3.2.1.2, tuna destined for export has its own specific value chain which generally involves operators landing fish in a port complex and exporting them directly (e.g., sashimi grade yellowfin tuna) or processing them in canneries or by frozen processors, before being loaded onto container ships which deliver the processed tuna to export markets. Conversely, if commercially caught fish are destined for the domestic market, they are distributed through a value-chain which typically includes the following actors: 1) *tag-iya sa panagatan* (the fishing operators/owners), 2) *tarima* (wholesalers or brokers), 3) "*toppers"* (middlemen), 4) vendors (retailers), 5) *listador* ('listers'), 6) dispatchers, 7) *kargadors* ('carriers'), 8) truck drivers, and 9) *mamuwaray* (dried fish vendors). Information described below on the role and likely incomes of these actors come from a single comprehensive study of Pasil market in Cebu city by Toring (2017).

Fishing operators or *Tag-iya sa panagatan* are responsible for fish supply and are normally owners of the fishing vessel and cargo trucks which transfer fish from the landing site to market, as well as employers of carriers (*kargadors*) and truck drivers which enable the transport of fish. In the economic pyramid, they are on the top.

Generally, the only people who have direct contact with the *tag-iya sa panagatan*, are the wholesalers and brokers who purchase their fish (i.e., the owners of '*tarima',* which refers to the small offices within the fish port). Wholesalers and brokers generally receive a portion of profits from the sale of fish (around 10%; Toring, 2017), with the remainder paid to the owner/ operator of the fishing vessel. In addition, brokers and wholesalers gain extra income via higher pricing of *bañera's* (circular trays which fish are transported in and sold from). In large markets such as Pasil in Cebu City, *tarima* owners handle 3-5 cargo trucks of fish a day, each containing around 200 *bañera's*, typically weighing around 30kg each and priced at 3,000-3,500 PhP, which equates to a gross income of around 200,000-300,000 PhP a day for each *tarima* owner. In addition, *tarima* owners in Pasil market earn additional profits from charging parking fees to container vans, of around 20 PhP per *bañera*, which equates to around 4,000 PhP per container van. Other than taxes on income (which are around 30,000 PhP annually in Cebu City), typical expenses of wholesalers include rental of space in the fish market (around 7,000 PhP per month in Pasil market) and wages of *kargadors, listadors,* and *dispatchers,* if hired.

"*Toppers*" are middlemen who buy fish wholesale from the *tarima* owners, add on a price premium per *bañera* (around 200 PhP in Pasil market), then sell *bañeras* onto vendors. In Pasil, this equates to

[24] https://www.wcpfc.int/labour_standards
[25] e.g., https://www.thaiunion.com/en/sustainability/social
[26] https://www.seafoodtaskforce.global/

an income of around 1,000-4,000 PhP per day. Toppers are not tied to a particular *tarima* owner (unlike the relationship between the *tarima* owners and the *tag-iya sa panagatan*) and generally shop around depending on the market demand for certain species. Toppers are accustomed to what species of fish are sold by each wholesaler and compete with one another to purchase from *tarima* owners, as generally there is no reservation of fish allowed.

Vendors buy fish from toppers and are engaged in the fish trade at a smaller scale, selling the fish by the kilogram to smaller vendors, who in turn sell directly to the consumer or return to their home municipality to sell to consumers located away from large markets. Profit varies according to the species of fish and negotiation skills of the vendor and consumer, but vendors ensure a price premium is added so that they do not lose money. If vendors cannot afford to buy a whole bañera, it is common for two to three vendors to team up and divide the cost.

Listadors list the names of toppers and the amount of fish exchanged in each transaction between toppers and *tarima* owners. Dispatchers gather toppers and arrange those transactions. Rather than paying wages of Listadors and Dispatchers, some *tarima* owners choose to personally perform both roles*,* while other *tarima* owners mobilize their relatives to do the job without pay.

Kargadors are typically men who carry fish at the fish port or fish market and are hired by the *tagiya sa panagatan, tarima* owners*,* and toppers. If a *kargador* works for the *tag-iya sa panagatan*, he also helps in transporting the fish from the ship into cargo trucks. In Pasil Market, Cebu city *Kargadors* earn around 20 PhP per *bañera*. Aside from the money they receive from transporting fish, they may also receive a kilo or a piece of fish as an additional incentive for their service.

Truck drivers deliver fish from the landing site to the fish market and are hired by the operator. On arrival at the market, *tarima* owners or dispatchers/ *listadors* check the number of bañeras in the truck. XX reports that "*A driver from Hagnaya, San Remegio Port would receive 7,000 PhP monthly wage plus 400 PhP allowance per trip. A single trip means going to the Pasil fish market and back to the Hagnaya port—about 6 hours travel time or 90 kilometers. On a busy day, my informant said that he can do two trips within 24 hours".*

Mamuwaray are those who buy fish from the *tarima* owners or toppers for the sole purpose of drying them (under the sun). Often the fish purchased for drying is "*dubok"* (no longer fresh but not yet rotten) and is sold by the *tarima* owners to *mamuwaray* for a significantly cheaper price (around a third of the fresh price in Pasil market). Dried fish is then often sold at smaller local markets away from the main market.

Irrespective of the role, it is common for those engaged in the value chain to receive a share of fish for home consumption on top of any cash income earnt.

It should also be noted that credit plays an important role in fish value-chains of the Philippines. Fishing operators (i.e., captains) often use credit from the vessel owner to run their boats, particularly when catches result in an economic loss. The speed of debt re-payment from the fishing operator to the vessel owner is determined by future catches. Debts associated with a single poor fishing trip can often take between 3 months to two years to pay off. Similarly, in the fish market, *listadors* record debts incurred by toppers who often use credit to purchase fish from *tarima* owners, with the repayment schedule determined through negotiations. To that end, an entire study could be conducted on the role of credit and the factors which determine net incomes in the commercial sector.

3.2.2.2 Marine Municipal Sector

Municipal fishers are considered the "poorest among the poor." Evidence from the published literature indicates that the mean gross daily income across studies amounts to less than 500 PhP or US$10 per day (Figure 24). Income depends on catch and subsequent sale of fish to local middlemen and vendors, or directly to consumers, generally from the landing site, small stalls located on beaches, or from the fisher's home. Low incomes can be, in part, attributed to declining fish catch, which is estimated to be about 5.3 – 13.7 kg/day/fisher (Anticamara & Go, 2016; Muallil et al., 2014), down from the reported average of 20 kg catch per day during the 1970s (Courtney et al., 2016).

In contrast to data on per employee income in the commercial sector, the two key independent studies which provided the vast majority of municipal income estimates determined both the gross income/fisher/day and the mean number of fishing days/fish/year (Muallil et al., 2014; Anticamara & go, 2016). Accordingly, below we have plotted the mean gross income/fisher/day based on the weight of fish landed multiplied by average fish price per kg (Figure 24a). This can be compared to gross income/employee/day estimated for other sectors. We have also plotted the gross annual income (Figure 24b) which gives a more realistic picture of income given the average annual number of fishing days undertaken is each region is variable. For the small number of additional studies that did not estimate the mean annual number of fishing days, it was assumed that municipal fishers fished 5 days per week (260 days per year).

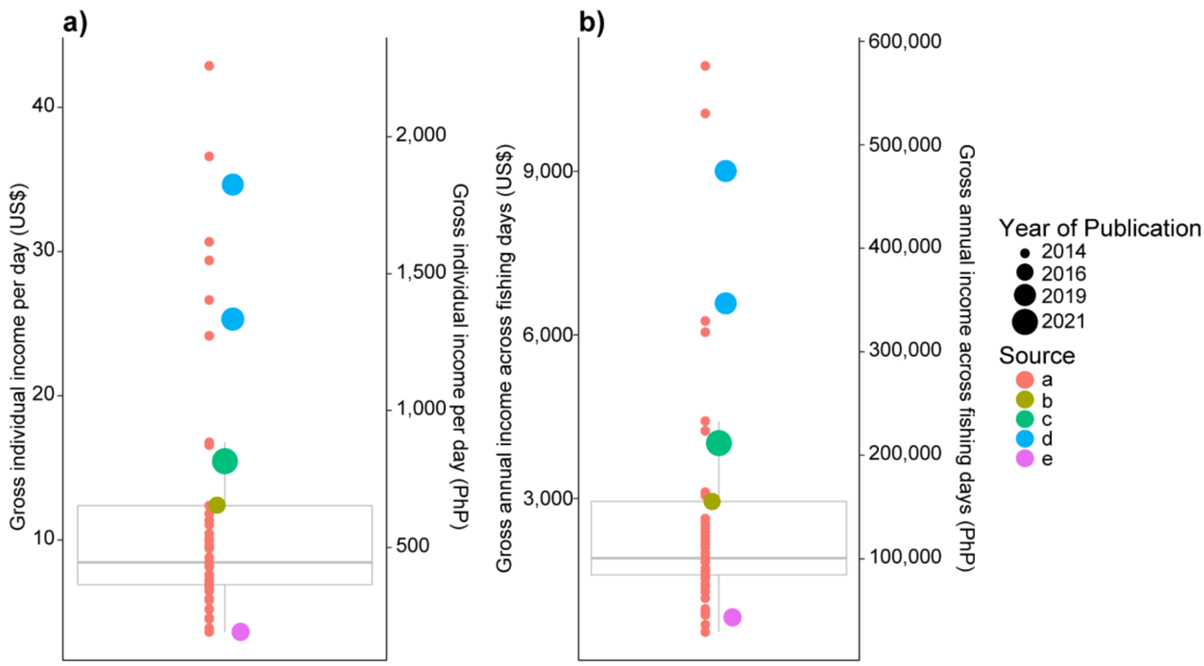

Figure 24: Gross daily (a) and annual (b) incomes of municipal fishers reported in the peer reviewed literature. Where published data were provided in USD using an old exchange rate (e.g., US$1 = 45 PhP; Muallil et al., 2014), data were readjusted to the USD:PhP conversion rate at the time of writing (US$1 = 52.59 PhP). Sources: a) Muallil et al., (2014), b) Anticamara and Go (2016), c) DOST (2021), d) dela Vega et al., (2019), e) Samonte et al., (2016). Individual datapoints represent location-specific income estimates.

We have been unable to locate any estimates of inland municipal per employee incomes in the published literature.

It is important to recognise that many municipal fishers in the Philippines fish for subsistence, with a portion of daily catch augmenting household food supply (commonly estimated at 10-15% of total daily catch; Cruz-Trinidad et al., 2014; Samonte et al., 2016). At a local level, municipal fishers in some locations may also trade their catch for other commodities (e.g., rice or other vegetables) which may reduce the gross incomes of individuals from the sale of fish, but further supplements food supply and results in lower relative food expenses when fishing is good (Fabinyi et al., 2017). As such, gross income estimates plotted above which assume all fish is sold at an average price per kilogram may be higher than the gross income of individuals in reality. Moreover, the above estimates of average incomes do not capture the fact that individual incomes will be highly dependent on the assets of the fisher. For example, it is not uncommon for municipal vessel owners to fish on another boat or engage in a separate income-generating activity while other fishermen work on their boat, which can increase their income (Fabinyi et al., 2017). Conversely, for low-income municipal fishing households that do not own their own fishing capital (e.g., boat, engine, fishing gears), access to larger or more valuable catches are limited without working on other people's boats, which involves splitting gross profits in favour of the vessel owner, thereby reducing net income of municipal fisher without fishing capital (Fabinyi et al., 2017). Similarly low-middle income fishing households may find it difficult to continue fishing if their boat or fishing gears break down, or if they are unable to secure enough capital to cover fuel and supplies to go on a fishing trip, resulting in a loss of income (Fabinyi et al., 2017). In addition to these caveats, it is difficult to provide discussion surrounding net income due to the variety of fishing activities and operational arrangements in the municipal sector. For municipal fishing households that own and fish with their own boat and gears, Anticamara & Go (2016) estimate that fuel costs around US$2.90 per day (after 7.3 hrs of fishing), resulting in a net income of <US$10 for most municipal fishers, a value similar to the mean income per fishing day estimated by Muallil et al (2014.) (Figure 24).

Few municipal fishers are engaged alternate livelihoods, with estimates of around 60% of municipal fishers relying upon fishing as their only source of income (Anticamara & Go, 2016; Muallil et al., 2011). This means the majority of municipal fishers earn <US$10 per fishing day and even less on average considering fishers do not fish every day of the year. This is barely enough to cover daily expenses and support their households which generally comprise 3.3 (± 1.5) dependents (Anticamara & Go, 2016; Muallil et al., 2014; Samonte et al., 2016). Moreover, in our experience, increased catches do not necessarily translate to higher incomes because fish prices are determined by the local market and by middlemen (who are often the local capitalists that provide financial capital to municipal fishers). These middlemen usually purchase municipal catches at a very low prices, especially when there is oversupply of fishes in the local market. In one of our focus group discussions with municipal fishers in Negros Occidental, some fishers related that they have been poor from the start, more than three decades ago, even when catches were still abundant and believe that they shall remain poor even when current catches improved because they believe that market price they believe will automatically drop. As municipal fishers generally have low capacity to access other markets and little to no ability to freeze/ store catches, due to financial and technological constraints or because they are indebted to their financier-middlemen, they are forced to sell their catch at the vendors or middlemen's price. In our opinion the lack of access regional markets and low capacity of municipal fishers to process and/or preserve their catch in top condition, thus demanding a higher price, are major constraints to increasing the incomes of municipal fishers and lifting coastal fishing communities out of poverty.

It is important to recognise that, even when offered substantial economic incentives from alternative livelihoods, or when faced with very low catches, many municipal fishers will continue to fish as fishing is seen as a historically and culturally significant occupation, in addition to providing income (Green et al., 2003; Muallil et al., 2011). Muallil et al., (2011) found that 50% of fishers interviewed reported that they would stay in the fishery even when daily catch is reduced to just 0.5 kg per day, which translates to less than US$1 or just 15% of the average fishers' daily household expenses (Figure 25). Similarly, 51% of fishers interviewed by Muallil et al., (2011) reported that they would continue to fish even when offered a monthly incentive of US$222 to exit the fishery, which is a large sum in the Philippines (Figure 25). This highlights the need for careful selection of livelihood support for municipal fishers.

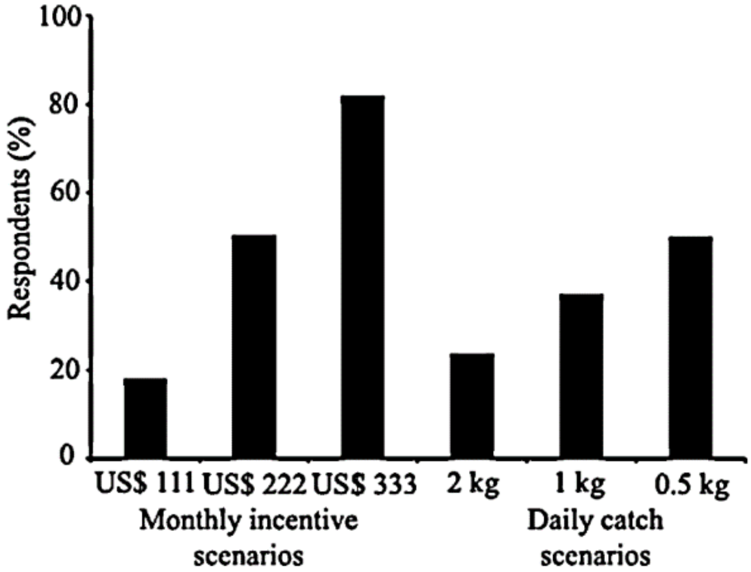

Figure 25: The proportion of fishers that would exit the fishery as a response to different low catch and monthly monetary incentive scenarios. Source: Muallil et al., 2011.

3.2.2.3 Aquaculture Sector

Similar to the commercial sector, the wages of aquaculture fish workers are regulated under the Labour Code of the Philippines and daily minimum wage rates that vary from region to region are set by the DOLE periodically (Table 7).

Table 7: Summary of current regional daily minimum wage rates (As of April 2022).

REGION	NON-AGRICULTURE	AGRICULTURE	
		Plantation	Non-Plantation
NCR	P500.00 - 537.00	P500.00	P500
CAR	340.00 - 350.00	340.00 - 350.00	340.00 - 350.00
I	282.00 - 340.00	295.00	282.00
II	370.00	345.00	345.00
III	369.00-420.00	354.00-390.00	342.00-374.00
IV-A	317.00 - 400.00	303.00 - 372.00	303.00 - 372.00
IV-B	294.00 - 320.00	294.00 - 320.00	294.00 - 320.00
V	310.00	310.00	310.00
VI	310.00 - 395.00	315.00	315.00
VII	356.00-404.00	351.00-394.00	351.00-394.00
VIII	325.00	295.00	295.00

IX	316.00	303.00	303.00
X	343.00 - 365.00	331.00 - 353.00	331.00 - 353.00
XI	396.00	391.00	391.00
XII	336.00	315.00	315.00
XIII	320.00	320.00	320.00
BARMM	300.00 - 325.00	290.00 - 300.00	290.00 - 300.00

However, unlike the commercial sector, we have been unable to find any published audits of wages paid in aquaculture operations over recent years to determine whether the DOLE minimum daily wage rates are correctly adhered to. Moreover, we have only been able to find a single study on the earnings of aquaculture workers post-2012 in the peer reviewed literature. Palanca-Tan & Bongat-Bayog (2021) documented the incomes of aquaculture workers on a tilapia farm in Lake Sebu, which showed that workers earnt well above the minimum wage set by DOLE.

It is possible that the employment model for contract labour in the aquaculture sector may increase the probability that the correct renumeration is paid to workers. Specifically, the labour directive of 2001 requires aquaculture businesses to contract jobs from labour cooperatives, which are responsible for the wages and benefits of their employees. In practice, this may add an extra layer of compliance. The contrasting argument is that the 2001 labour directive prevents the formation of worker unions and may act as an instrument to avoid hiring full-time workers, and thereby avoid paying wage increases and other benefits (Hishamunda et al., 2014). Such a situation has previously resulted in a large foreign-owned agribusiness in Mindanao being subject to criticisms for allegedly using the scheme in an exploitative way (Hishamunda et al., 2014). Ultimately, more research is required to determine the wages of aquaculture workers in the Philippines.

There are also few published studies which have determined the income earnt by major actors involved in Philippine aquaculture value chains and unfortunately, due to the varying scale and location of aquaculture operations studied, it is difficult to assess the value obtained by major actors across operations. Nevertheless, below we detail results of available studies on milkfish and tilapia culture, the top two species in terms of total production value and individual consumption.

Across milkfish mariculture operations in Misamis Oriental, Northern Mindanao, Roxas et al., (2017) determined the revenue gained by each major actor (Table 8). By extrapolating this out by the mean number of cages and yield/cage of fish operators we can gain an appreciation for the possible revenue that private tilapia fish cage operators may earn annually (Table 8). We have chosen not to extrapolate such values for other actors as it is unclear whether they could handle such a large yield twice a year (e.g., retailers are only capable of selling ≈400 kg of milkfish in 1-2 days; Roxas et al., 2017).

Table 8: Revenue (value-added) by various actors in milkfish mariculture operations in Misamis Oriental, Northern Mindanao, conservatively assuming 2 harvest per year. Data source: Roxas et al., (2017).

	Private (big and medium) fish cage operators (80% men)	Brokers/Traders (75% men)	Wholesalers (mostly women)	Retailers (mostly women)
Selling price/kg (PhP)	92	105	110	125
Cost of milkfish/kg (PhP)	74.07	92	105	110
Total cost of inputs (PhP)	80.89	92.95	-	112.54

Revenue per kg (gross profit-total costs)	11.11	12.05	5	12.46
Number of cages	Big operators = 7-14 Medium operators = 2-6			
Yield/ fish cage (t)	Big operators = 7.5-30t Medium operators = 7.5-8t			
Annual value added	Big operators = 1,166,550 - 9,332,400 (US$25.9-207.4k); Medium operators = 333,300-1,066,560 (US$7.5-23.7k)			

Across actors, the gross revenue per kg was estimated to be PhP 40.62. Value additions were primarily derived by male fish cage operators, estimated at PhP 11.11/kg after four months of production or during harvest time (27.4 % of value added) (Roxas et al., 2017). Brokering and trading of milkfish was also generally conducted by males and generated 29.7 % of value added (12.05PhP/kg) (Roxas et al., 2017). Women were primarily wholesalers and retailers of milkfish, with the former generating 12.3 % of value-added (5PhP/kg/day), while the latter generated the highest value addition in the chain of 12.46PhP/kg/day (30.7 % of value added); however, retailers are only capable of selling ≈400 kg of milkfish in 1-2 days (Roxas et al., 2017).

It is notable that the Philippine Department of Agriculture provide a substantially lower estimate of the average profit from milkfish culture on a per hectare basis (DA, 2019), likely due to the inclusion of small fishpond operators (who do not benefit from economies of scale) and multiple culture techniques.

Table 9: One-hectare average costs and returns of milkfish production. Data source: Department of Agriculture.

ITEM	AMOUNT (in PhP per hectare)
CASH COSTS	34,741
Stocking materials	13,475
Feeds	4,789
Fertilizer	2,646
Pesticides and other chemicals	487
Hired labor	4,725
Salaries of permanent employees	3,431
Land tax	421
Rentals	3,355
Fuel and oil	375
Transport cost of inputs	174
License/ permit	6
Electricity	183
Interest payment on loan	89
Food expenses	244
Repairs	285
Others	55
NON-CASH COSTS	
Harvester's share	847
Caretaker's share	320
Other labor's share	188
Administrator's share	87
Lease rental	60
Rice allowance of overseer	186
IMPUTED COSTS	
Operator labor	10,392
Family labor	232
Exchange labor	7
Depreciation	2,331
Interest on operating capital	2,058
Rental value of owned land	5,602
TOTAL COSTS	45,980
GROSS RETURNS	111,640
GROSS RETURNS ABOVE CASH COSTS	76,899
GROSS RETURNS ABOVE CASH AND NON-CASH COSTS	76,052
NET RETURNS	65,660
NET PROFIT-COST RATIO	1.43
Cost per kilogram (PhP)	41.43
Yield per hectare (kg/ha)	1.110
Farmgate price (Php/kg)	100.59

Table 10 sets out the gross annual revenues and net incomes of major actors involved in a Lake Sebu tilapia farm, as reported by Palanca-Tan & Bongat-Bayog (2021).

Table 10: Revenues and likely incomes of various actors involved in tilapia culture in Lake Sebu. Data source: Palanca-Tan & Bongat-Bayog (2021).

	Nursery owner/operator (Fingerling supplier)	Owner/ operator	Wholesale trader	Retail trader
Annual revenue (PhP)	600,000	281,394[2]	Not reported	Not reported
Net annual income (PhP)	236,550[1]	Not reported	52,000-234,000 [3]	26,000 – 286,000 [4,*]

1 Based on monthly production costs of PhP 30,000, a fingerling stocking cost of 1000, and assuming the nursery owner/operator makes three harvests in a year, each of about 571 kg, with price per kg of about PhP 350. Estimate does not include one off construction costs of around 150,000 PhP.
2 Assuming the Owner/ operator seeds its farms four times in a year using about 32 kg of fingerlings each time, and harvests about 828 kg of fish three times a year.
3 Assuming weekly transactions of about 50 - 180 kg per transaction and sell at a margin of about PhP 20 - 25 per kg of fish, resulting in a net income of PhP 1000 - 4500 per transaction.

4: Daily revenues range from PhP 1300 to PhP 6500 with a cost of PhP 1200 to PhP 5900, thus generating a net profit of PhP 100 –1100.
*figure assumes retailers sell tilapia 260 days a year.

Compared to the previous milkfish case study in Northern Mindanao it is evident that this particular operation in Lake Sebu is far smaller and thus less profitable overall. Nevertheless, it is evident that both operations sell their fish to wholesalers and traders for a similar price, with the tilapia owner/operator selling tilapia for about 98Php per kg produced (after accounting for the cost of fingerlings), compared to the milkfish mariculture owner operator which charged 90PhP for each kg of milkfish produced. Conversely, for each kilogram traded or sold by wholesalers, the milkfish actors earnt 12.05PhP while tilapia actors earnt PhP 20-25. A slightly older study performed by Ramirez et al., (2019) on tilapia ponds in Luzon provides a similar estimate of the value-added by grow out operators of 24.51 PhP. However, it is notable that Ramirez et al., (2019) provides much lower estimates of the value added by hatchery operators, wholesalers, and retailers, of 1.55, 9.14 and 9.51 PhP/Kg of tilapia, respectively. It is likely such differences stem from spatial and establishment-specific differences in the size and therefore price of tilapia fingerlings stocked, and differences in market demand, farmgate prices, and variable scale of each establishment studied.

4 The Contribution of Fisheries to Domestic Seafood Consumption

National nutrition surveys (NNS) conducted by Philippine Department of Science and Technology – Food and Nutrition Research Institute (DOST-FNRI) have provided regular information on domestic seafood consumption across the Philippine population since 1978. As per requests by LGUs, the Congress of the Philippines, and other stakeholders for local-level data to be used for their local development plans, in 2018 the DOST-FNRI survey methodology was expanded from the usual five-year NNS to a three-year rolling survey to cover all 117 areas (81 provinces, 33 highly urbanized cities (HUCs) and three urban areas) of the country from 2018 to 2018 to 2020 (however, due to the COVID-19 pandemic, year 3 of the survey was moved to 2021 to cover the remaining 37 areas). This chapter is based on by data collected during the 2018-19 years of the Expanded National Nutrition Survey (ENNS), comprising data collected from 163,235 individuals and 41,204 households distributed throughout the Philippines. An overview of the ENNS sampling design and methods can be found in DOST-FNRI (2020). Location specific sample sizes used in this report can be found in Annex 2.

4.1 National level

Seafood has been a historically important source of nutrition for Filipinos but estimates of seafood consumption per individual have long been in decline. In 1993, it was estimated that individuals consumed approximately 36 kg of seafood per year and in 2018-19 data from the DOST-FNRI ENNS indicated the average annual edible portion weight of seafood consumed per individual is now equivalent to 14.32 kg. At the household level, this equates to approximately 113.31 kg of edible seafood consumed annually. The majority is consumed as fresh fish, with processed fish, crustaceans and molluscs accounting for smaller proportions of seafood consumption (Table 11).

Table 11: Average consumed edible portion weight of fresh fish, processed fish, crustaceans and molluscs by individuals and households at a national level. Data source: DOST-FNRI 2018-19 ENNS.

	Average daily consumption per individual (edible portion weight in grams)	**Average household daily consumption (edible portion weight in grams)**
Fresh fish	32.21 (+/- 1.25)	231.46 (+/- 6.73)
Processed fish	3.43 (+/- 0.18)	48.15 (+/- 3.07)
Crustaceans and molluscs	3.58 (+/- 0.25)	30.83 (+/- 2.70)

Sample size: individuals = 163,235, households = 41,204.

There are a number of factors which currently limit our ability to robustly determine the relative contribution each fishery sector to domestic seafood consumption and food security: 1) most species differentiated by the DOST-FNRI ENNS are landed by multiple sectors, but it is unclear where seafood was purchased or caught by those surveyed in the ENNS, which would allow for some inference regarding the source fishery, 2) official landings data is inherently uncertain both in terms of volumes and species, particularly for marine municipal sector, which confounds our understanding of domestic supply, 3) the quantity of landings exported by commercial fisheries is often unclear or highly uncertain, 4) seafood imports and their subsequent value chains are similarly uncertain, 5) many categories recorded by the DOST-FNRI ENNS are not taxonomically specific but instead were classified based on the state of food before consumption (e.g., dried fish, canned fish), and 6) surveys for the ENNS are taken at one-point-in-time and thus don't account for seasonal variation in seafood supply, consumption, or dependence on seafood for food security. Each one of these factors offer opportunity for future study. Nevertheless, based on the available data and our knowledge of catch utilisation, below we discuss the likely source fisheries which relate to commonly consumed seafood categories at a national level.

In 2018-19, the most commonly consumed taxa at a national level were tilapia, round scad, and milkfish, collectively accounting for around 39% of the total weight of seafood consumed per individual (Figure 266). Other commonly consumed categories included “Other fresh fish and cooked fish recipes” (comprising low taxa-specific volumes of miscellaneous species listed in annex 3), frigate tuna, canned fish (e.g., tuna, sardines, mackerel etc.), and big-eyed scad (Figure 26). Tilapia and milkfish are primarily produced through aquaculture/ mariculture, while round scad and species which contribute to the “canned fish” category are primarily caught by the commercial sector, with domestic landings supplemented by international imports. Frigate tuna is landed in approximately equal proportions by the commercial and marine municipal sectors, while marine municipal landings contribute more to domestic supply of big-eyed scad and likely the “Other fresh fish and cooked fish recipes” category (see species listed in annex 3). Dried fish (ranked 6th in Figure 26) is also likely sourced primarily from landings of the marine municipal sector, albeit the non-species-specific nature of this category and generally unclear processing of commercial landings mean this is difficult to confirm. The remaining three commonly consumed taxonomic groups (Bali sardinella, squid/octopus, and yellowfin tuna; Figure 26) are all caught in greater quantities by the commercial sector than the municipal sector, albeit commercially caught yellowfin is a key export commodity and both yellowfin tuna and sardines are canned in unknown quantities. Accordingly, the proportion of fresh yellowfin tuna and sardines sourced from the municipal catch remains unclear.

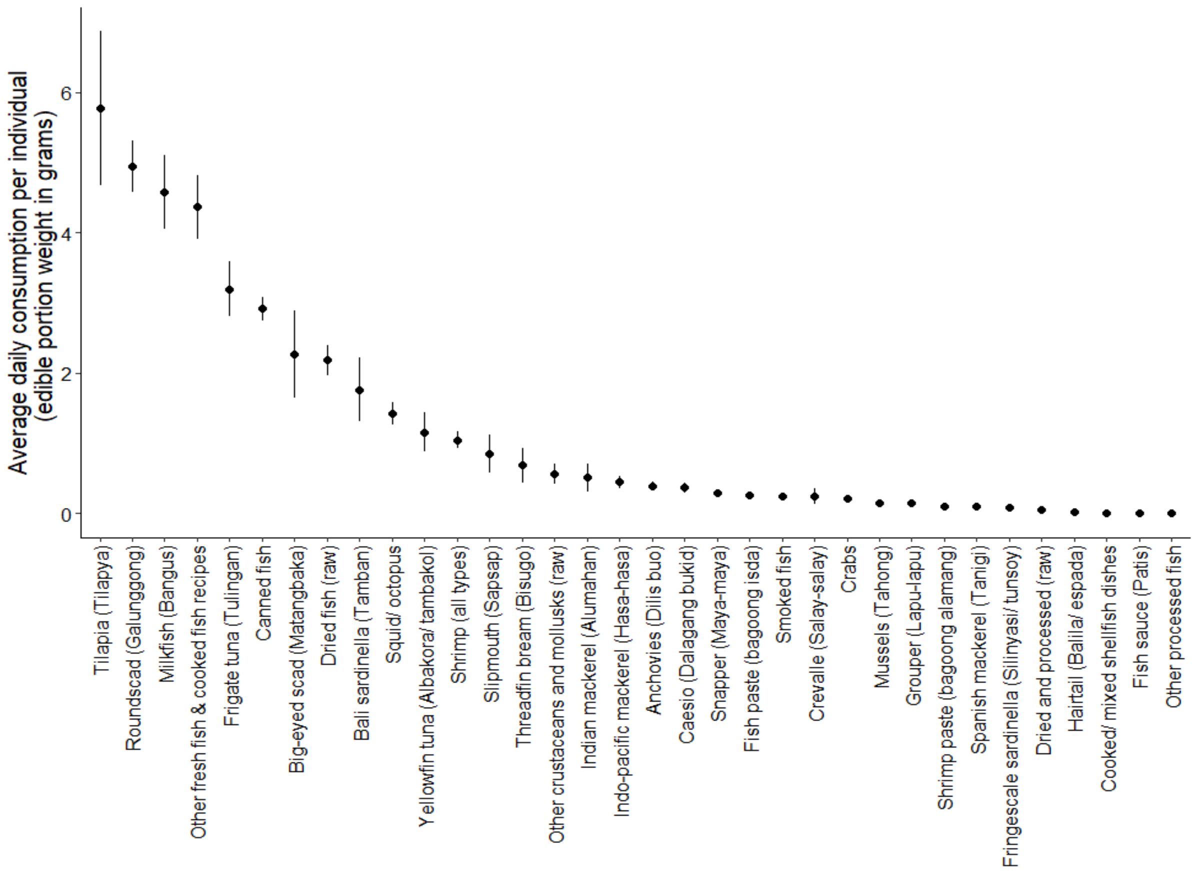

Figure 26: Most commonly consumed taxa/seafood categories at a national level. Data source: DOST-FNRI 2018-19 ENNS.

Ultimately, based on the weight of consumption across seafood categories in Figure 26, commercially caught pelagic species[27] appear the most important for food security at a national level. Although the species harvested by the marine municipal sector are each consumed in lower volumes than those produced by the commercial or aquaculture sectors, the large number of species harvested and the fact that much of the catch is consumed domestically means that the marine municipal sector is likely to provide the second most important contribution to food security at a national level. Despite accounting for the greatest production volume of all sectors, aquaculture is likely ranked third in terms of contribution to domestic food security, noting that several aquaculture produced products are primarily farmed for export (e.g., prawns/ shrimp). The inland municipal sector provides the lowest catch of the four sectors and lowest contribution to food security at the national level.

It remains unclear exactly what combination of factors drive domestic consumers to eat the top seafood categories in Figure 26. While tilapia and round scad are the most popular species consumed at a national level and are cheaper on a per kg basis than other commonly consumed species, it is notable that milkfish (ranked 3rd) is relatively expensive across regions compared to other commonly consumed taxa ranked lower in terms of consumption (e.g., frigate tuna and big-eyed scad; Figure 27).

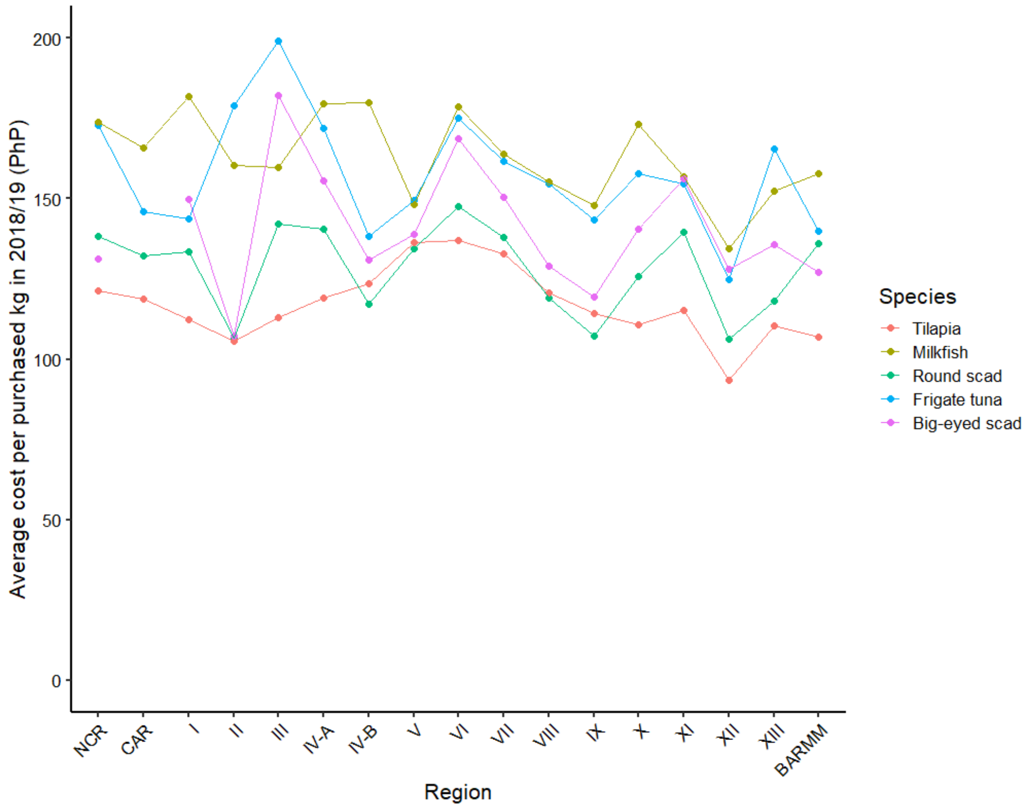

Figure 27: Cost of commonly consumed species in 2018-19 at a regional level within the Philippines. Regional estimates were generated from data obtained during surveys of individuals in specific provinces/HUCs during the 2018-19 DOST-FNRI ENNS, sample sizes are in Annex 2.

[27] While we term these taxonomic groups 'pelagic' based on their ecology and due to a lack of species-specific landings data, it should be acknowledged species within these groups (e.g., *Selar crumenophthalmus, Decapterus macrosoma, Decapterus punctatus*) are in fact reef associated species, as per studies from the peer reviewed literature (Geronimo & Cabral, 2014; Newton et al., 2007) and fishery management plans (WPRFMC, 2001).

Aquaculture produced seafood is more available, both spatially and temporally, which likely contributes to its popularity among Filipino consumers. Farmed seafood has also undergone fewer price hikes through time when compared to wild catch seafood, with aquaculture product only rising 6-fold in price between 1980 and 2014, while municipal and commercial catches have risen eleven-fold and 7-fold respectively over the same period (Palanca-Tan, 2018). This may indicate that the relatively stable costs of farmed seafood though time contributes to its popularity among consumers. Ultimately, further research is required to disentangle the relative importance of seafood availability and price from one-another, and from other factors likely influencing consumption patterns of Filipinos, such as taste, freshness, and perceived nutritional benefit.

Data from the DOST-FNRI ENNS suggests that the consumption of fresh fish among urban and rural consumers does not differ greatly at the national level, while rural consumers generally consume more processed fish, crustaceans and molluscs (Table 12). A stronger trend is evident among wealth levels, with the 2018-19 ENNS corroborating previous conclusions that the quantity of fresh fish consumed increases with the level of wealth (Cruz-Trinidad, 2003). Conversely the amount of processed fish consumed at the household level generally declines as wealth increases, while the consumption of crustaceans and molluscs only increases in the richest households, with relatively similar consumed weights evident among the poorest, poor, middle, and rich households (Table 12). This result is somewhat unsurprising given that higher levels of wealth have long been associated with greater consumption of proteins, both meat and seafood, and that fishing communities of low socioeconomic standing have previously been identified to consume lower quantities of seafood than wealthier Filipinos, despite making the consumption of seafood possible for these individuals (Cruz-Trinidad, 2003).

Table 12: Household daily consumption volume of fresh fish, processed fish, crustaceans and molluscs according to urbanicity and wealth quintile. Data source: DOST-FNRI 2018-19 ENNS.

	Fresh fish	**Processed fish**	**Crustaceans and molluscs**
Urbanicity			
Rural	232.06 (+/- 8.54)	51.55 (+/- 3.52)	33.94 (+/- 2.23)
Urban	231.56 (+/- 10.05)	43.27 (+/- 2.93)	26.31 (+/- 2.43)
Wealth level			
Poorest	179.65 (+/- 8.87)	53.66 (+/- 3.67)	30.65 (+/- 4.34)
Poor	210.85 (+/- 11.50)	56.90 (+/- 4.06)	26.76 (+/- 3.91)
Middle	239.37 (+/- 9.86)	48.26 (+/- 4.16)	29.91 (+/- 4.44)
Rich	258.34 (+/- 12.55)	42.68 (+/- 4.64)	29.56 (+/- 4.64)
Richest	287.06 (+/- 11.81)	35.11 (+/- 3.95)	37.75 (+/- 4.94)

Greater variance in the consumption patterns of urban and rural consumers are evident at the taxonomic level, with rural consumers eating significantly greater amounts of canned fish, dried fish, fish paste, and various “Other” species which are individually recorded but lumped together by DOST-FNRI due to low taxa-specific consumption volumes (see annex 3 for list of species in “Other fresh fish and cooked fish recipes” and “Other processed fish” categories) (Figure 28).

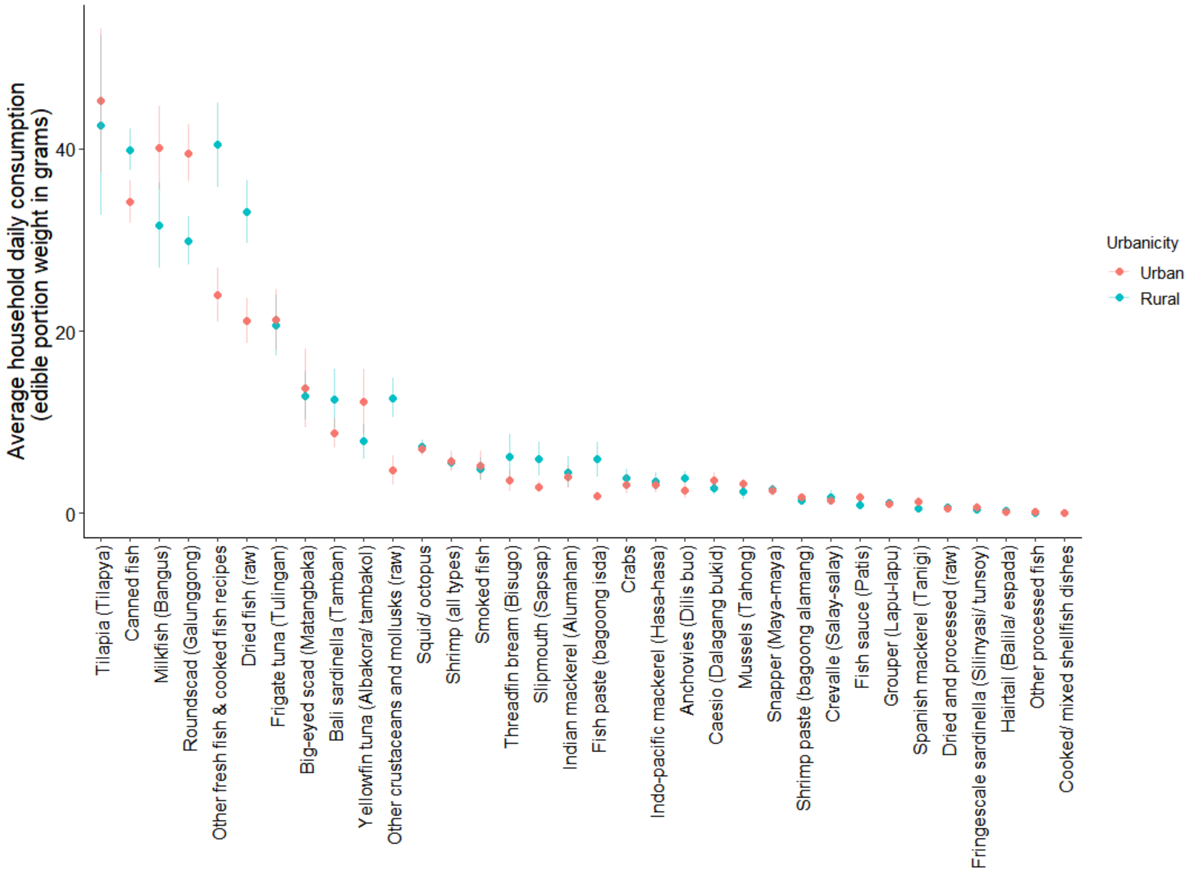

Figure 28: Household daily consumption volume of various taxa/ seafood categories according to urbanicity. Data source: DOST-FNRI 2018-19 ENNS.

When examining the consumption patterns of the various wealth quintiles at a more granular level, it is evident that wild-caught marine pelagic species are consumed in similar relative proportions irrespective of wealth (Figure 29). Conversely, the proportion of consumption weight of species produced primarily through aquaculture and mariculture (i.e., milkfish, tilapia) progressively increase with the wealth of the individual, while the consumption of canned fish and dried fish generally declines with increased wealth (Figure 29).

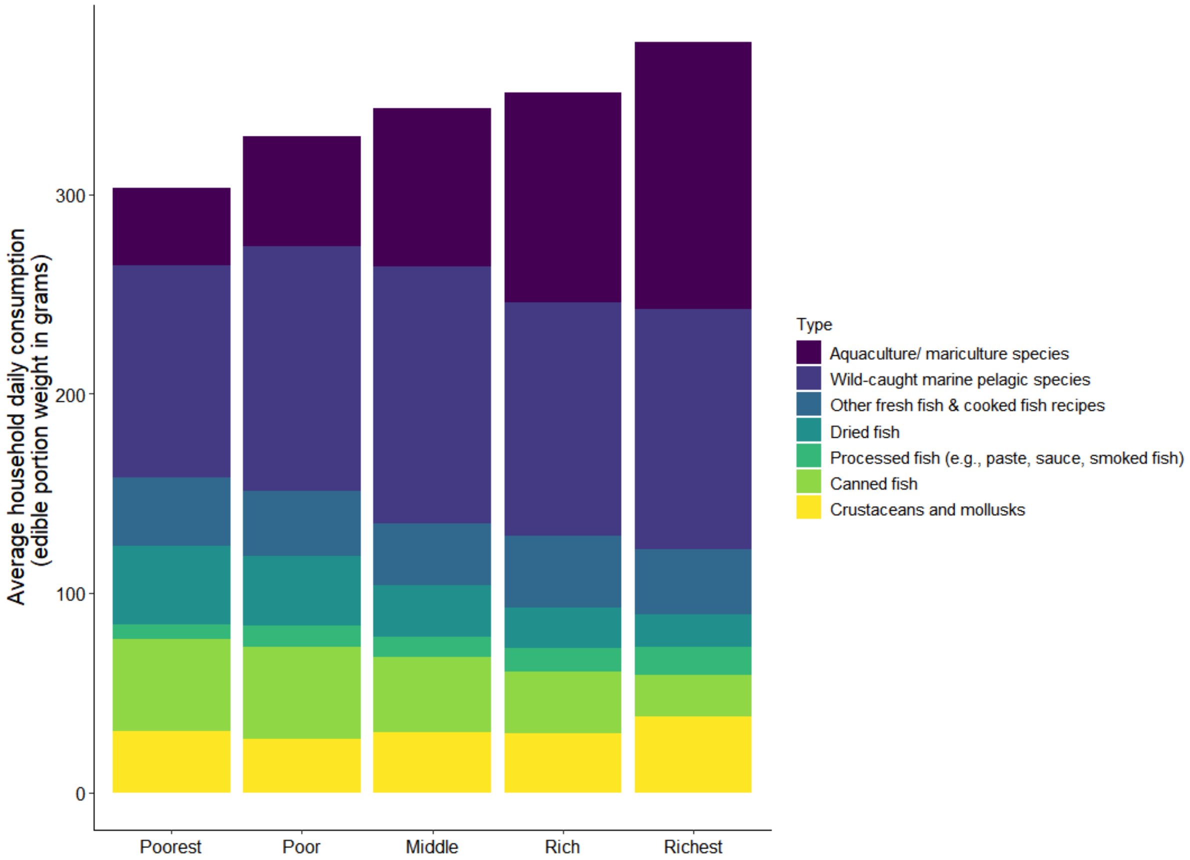

Figure 29: Daily household consumption volume of various types of seafood products according to wealth level. Data source: DOST-FNRI 2018-19 ENNS.

4.2 Regional level

There is substantial variance in the quantity of seafood consumed at the regional level, with those in the Cordillera Administrative Region (CAR) and National Capital Region (NCR) consuming the least fresh fish per day, while those in Zamboanga Peninsula (Region IX) consumed the greatest proportion of fresh fish per day. In fact, at a regional level there appears to be a general decline in the proportion of fresh fish consumed as latitude increases (Figure 30), with those located in southern areas of the country (Regions VI to BARMM) and MIMAROPA (Region IV-B) consuming more fresh fish on average than those in northern regions (Regions NCR to IV-A and V). This spatial trend in fish consumption does not correlate with the distribution of fishers or the population and requires further investigation.

While the high relative consumption of fresh fish in southern regions initially appears contradictory to results plotted above for the various wealth levels (Figure 29), given that southern regions generally have higher incidence of poverty and subsistence, it is evident that there were relatively few households classified in the “richest” and “rich” categories surveyed by DOST-FNRI in southern regions and thus these regions contributed less to national results plotted in Figure 29. There is evidence of significantly higher fresh fish consumption among “poor” consumers in southern regions and more “poor” households surveyed in these regions, relative to individuals within regions located in the north of the country. Accordingly, the regional results plotted in Figure 30 reinforces the idea that seafood is a cheap and available food source for those on low incomes in the Philippines. In 2018-19, there was less variance in the amount of processed fish, crustaceans and molluscs consumed at a regional level and no clear trend across regions (Figure 30).

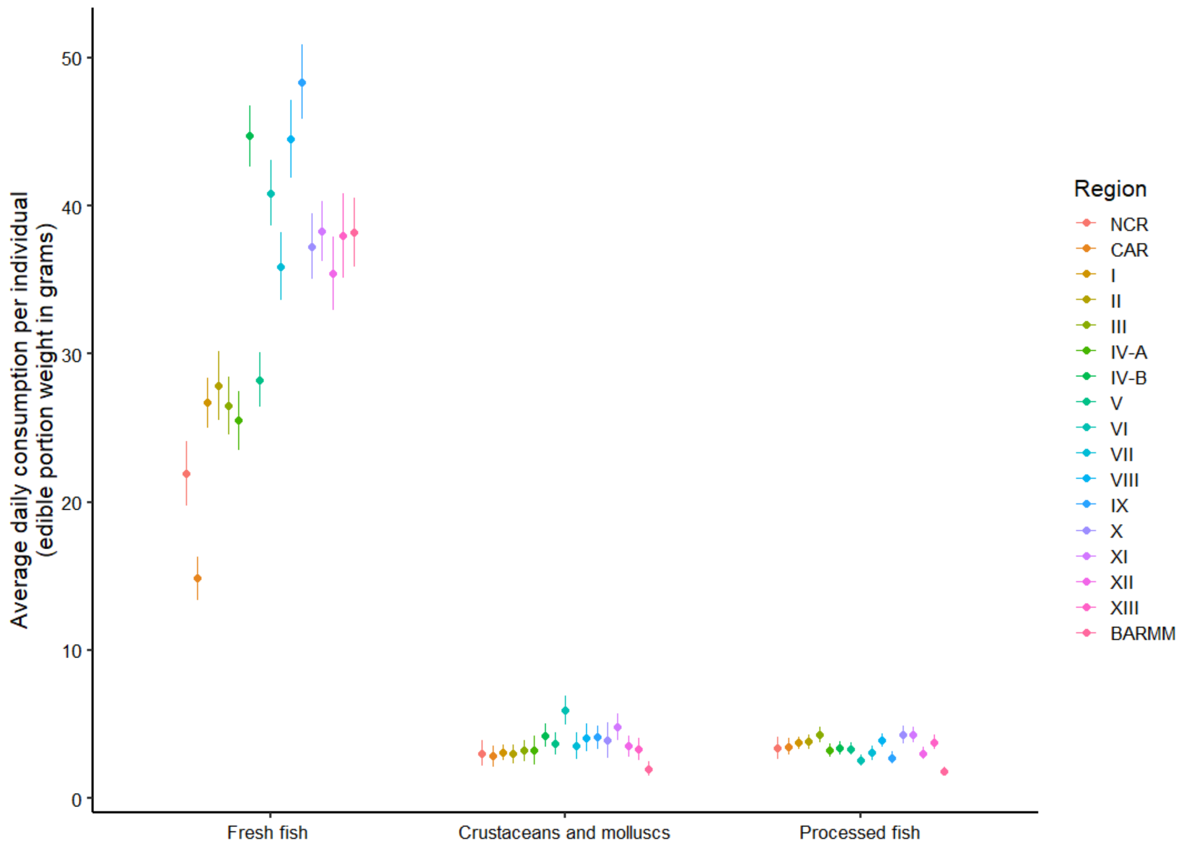

Figure 30: Average daily consumption of fresh fish, crustaceans and molluscs, and processed fish by individuals in each region of the Philippines. Regions are plotted left-right in declining order of legend. Colours appear as per legend. Regional estimates were generated from data obtained during surveys of individuals in specific provinces/HUCs during the 2018-19 DOST-FNRI ENNS, sample sizes are in Annex 2.

At a taxa-specific level, the top three consumed species/ species groups differ greatly among administrative regions of the Philippines (Table 13, Figure 31). Tilapia and milkfish appear particularly popular in the north of the country (Regions NCR, CAR, I, II, III, IV-A) and in BARMM, while marine pelagic species and “Other fresh fish and cooked fish recipes” are more commonly consumed in other regions (Table 13, Figure 31).

Table 13: Top three species consumed by individuals in each region of the Philippines. Regional estimates were generated from data obtained during surveys of individuals in specific provinces/HUCs during the 2018-19 DOST-FNRI ENNS, sample sizes are in Annex 2.

Region	Top 3 consumed taxa/categories	Average daily individual consumption (edible portion weight in grams)	Region	Top 3 consumed taxa/categories	Average daily individual consumption (edible portion weight in grams)
	Milkfish (Bangus)	5.73		Round scad (Galunggong)	8.54
NCR	Tilapia (Tilapya)	5.46	VII	Other fresh fish & cooked fish recipes	8.53
	Round scad (Galunggong)	4.78		Frigate tuna (Tulingan)	4.5
	Tilapia (Tilapya)	4.9		Other fresh fish & cooked fish recipes	8.8
CAR	Milkfish (Bangus)	4.65	VIII	Round scad (Galunggong)	8.42
	Canned fish	2.69		Bali sardinella (Tamban)	5.52
	Tilapia (Tilapya)	8.06		Big-eyed scad (Matangbaka)	10.87
I	Milkfish (Bangus)	6.95	IX	Round scad (Galunggong)	9.22
	Round scad (Galunggong)	4.14		Frigate tuna (Tulingan)	6.99
	Tilapia (Tilapya)	8.17		Big-eyed scad (Matangbaka)	8.01
II	Big-eyed scad (Matangbaka)	4.52	X	Frigate tuna (Tulingan)	7.25
	Milkfish (Bangus)	3.96		Other fresh fish & cooked fish recipes	6.36
	Tilapia (Tilapya)	10.71		Frigate tuna (Tulingan)	8.22
III	Milkfish (Bangus)	4.95	XI	Big-eyed scad (Matangbaka)	7.73
	Canned fish	3.36		Other fresh fish & cooked fish recipes	6.17
	Tilapia (Tilapya)	7.92		Tilapia (Tilapya)	7.82
IV-A	Milkfish (Bangus)	4.03	XII	Frigate tuna (Tulingan)	6.74
	Round scad (Galunggong)	3.98		Round scad (Galunggong)	5.11
	Other fresh fish & cooked fish recipes	8.71		Other fresh fish & cooked fish recipes	9.72
IV-B	Round scad (Galunggong)	8.48	XIII	Frigate tuna (Tulingan)	5.41
	Frigate tuna (Tulingan)	5.84		Indian mackerel (Alumahan)	3.59
	Other fresh fish & cooked fish recipes	5.19		Big-eyed scad (Matangbaka)	8.25
V	Tilapia (Tilapya)	4.36	BARMM	Round scad (Galunggong)	7.46
	Round scad (Galunggong)	3.97		Tilapia (Tilapya)	7.18
	Milkfish (Bangus)	12.03			
VI	Round scad (Galunggong)	5.37			
	Other fresh fish & cooked fish recipes	4.51			

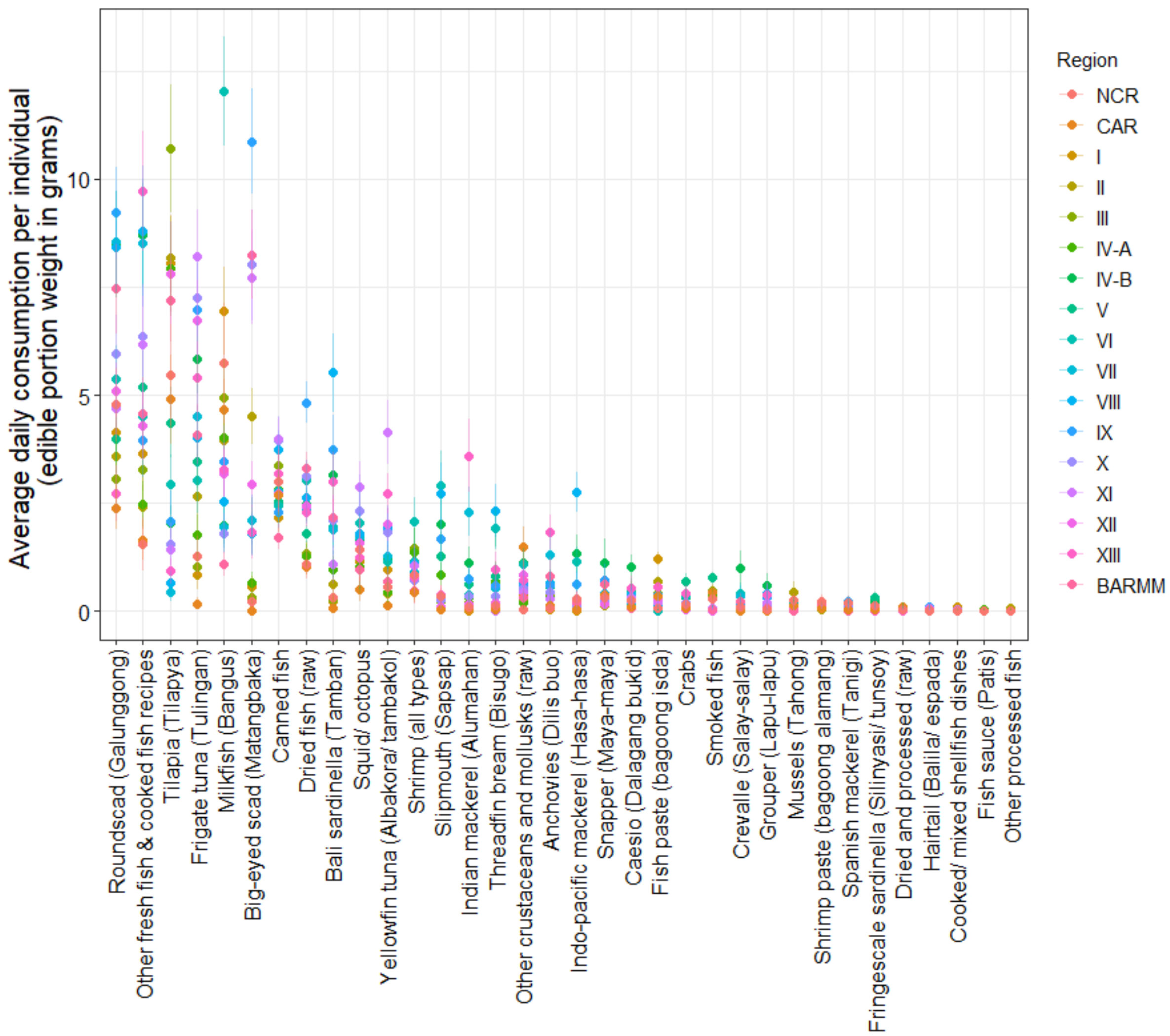

Figure 31: Average daily consumption of taxa/seafood categories by individuals in all 17 regions of the Philippines. Regional estimates were generated from data obtained during surveys of individuals in specific provinces/HUCs during the 2018-19 DOST-FNRI ENNS, sample sizes are in Annex 2.

4.3 Relevance of Seafood Consumption Patterns to Nutrition

This project was undertaken to assess patterns of domestic seafood consumption based on consumed weight, but it is well known that the nutrient composition of fish varies considerably among species. Accordingly, the consumption of certain fishes can provide greater nutritional benefit to the consumer (Hicks et al., 2019; Vaitla et al., 2018). To that end, although milkfish and tilapia are more commonly consumed than various other wild-caught pelagics (e.g., scads, tuna, mackerel, sardines), these species generally provide lower nutritional benefit per serve (Figure 32). Specifically, milkfish and tilapia generally comprise lower amounts of protein, calcium, Vitamin A, and marginally lower amounts of Omega-3's, iron, and selenium than the various wild-caught pelagic species per serve (Figure 32).

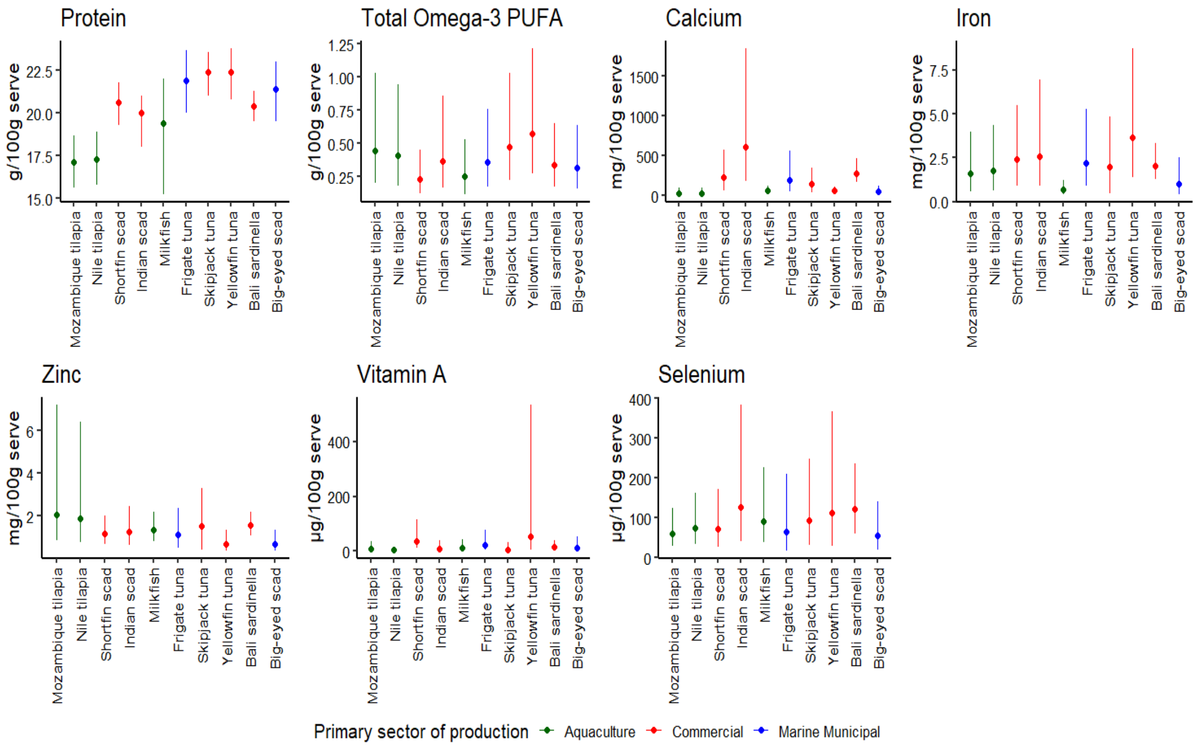

Figure 32: Nutritional composition of the top 6 most consumed species/ species groups in the Philippines (excluding "Other fresh fish and cooked fish recipes" ranked 4th, due to non-taxa specific nature of category). Tilapia (mozambique tilapia, nile tilapia), round scad (shortfin scad, Indian scad), milkfish, frigate tuna, canned fish (e.g., skipjack tuna, yellowfin tuna, Bali sardinella), big-eyed scad. Data points and 95% confidence intervals coloured according to the primary sector of production, as per legend. Data source: FishBase.

While the differences in Figure 32 appear small at the 100g serve scale, the nutritional benefits of consuming a greater proportion of the top two wild-caught pelagic species, round scad and frigate tuna, are strongly evident at a macro level, among regions of the Philippines (Figure 33). Such results emphasise the importance of considering the nutritional composition of consumed fish species, rather than just the gross weight of consumption, when designing policies and programs aimed at improving food and nutrition security.

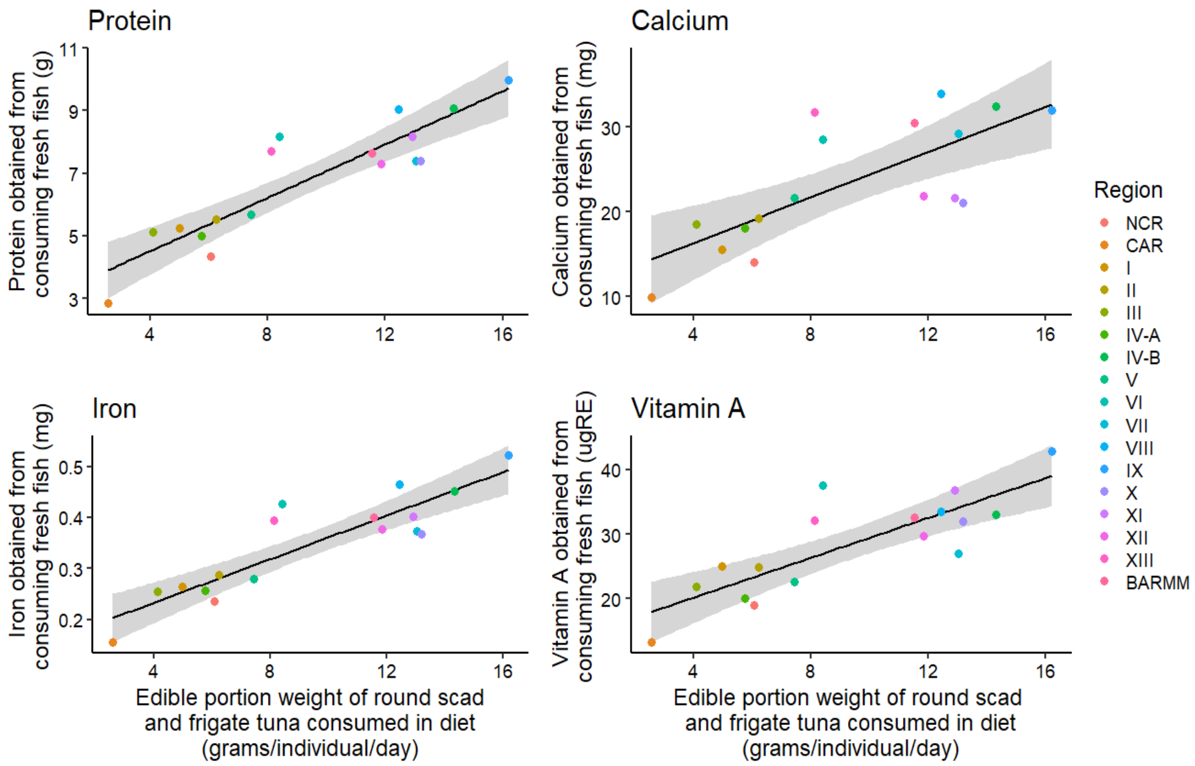

Figure 33: Linear regressions between the amount of round scad and frigate tuna consumed (x-axis) and the various nutrients obtained from consuming fresh fish more generally (y-axis). Regions coloured as per legend. Regional estimates were generated from data obtained during surveys of individuals in specific provinces/HUCs during the 2018-19 DOST-FNRI ENNS, sample sizes are in Annex 2.

Nevertheless, despite the nutritional benefits associated with the greater consumption of fresh fish in southern regions, including high consumption of round scad and frigate tuna, these regions also have the highest prevalence of underweight and stunting among children and adolescents (see 2.2). For these reasons, it appears that seafood consumption in southern regions is critically important in supporting the current level of food security, but the consumption of other high energy foods such as rice and vegetables are likely similarly influential in determining food security. By assessing whether nutrient intakes from seafood consumption meet the minimum dietary requirements of individuals and households, future studies may be able to tease apart the role of seafood from other food groups in determining food security and elucidate the degree to which seafood consumption, or the consumption of particular species, would need to increase in southern regions to bolster food security.

5 Discussion

At the national level, aquaculture produced milkfish and tilapia were ranked 1st and 3rd most consumed species in 2018-19, collectively comprising ≈26% of total seafood consumption per individual. The prevalence of cultured milkfish and tilapia in Philippine fish markets, both spatially and temporally, along with the relatively cheap and stable price of these species (particularly tilapia) through time (Alviola et al., 2013) have all likely contributed to the popularity of these species among consumers. Despite milkfish being cultured in higher volume at the national level, it is not surprising that tilapia is currently the most consumed species in the Philippines given that market prices of tilapia in 2018-19 were lower than all other commonly consumed fish species, including the cheapest fish historically, round scad (which was ranked 2nd in terms of consumption). Nevertheless, milkfish and tilapia offer fewer nutrients per serve compared to the diverse suite of pelagic species landed by wild capture fisheries. The aquaculture sector also employs far fewer people than wild capture fisheries, is capital intensive, and often environmentally destructive. National data on tilapia culture also indicates that production has stalled (Guerrero, 2019). For these reasons, aquaculture and capture fisheries need to play complementary roles to achieve improved food security and livelihoods.

Across wild capture fisheries, the landings of pelagics[28], both small (e.g., scads) and large (e.g., tuna), provide the greatest contribution to the national economy and fisher livelihoods (employment, income). These taxa are also more nutritious than cultured milkfish and tilapia per serve and are important for food security at the national level, with round scad, frigate tuna, and canned fish (e.g., tuna, sardines, mackerel) cumulatively comprising ≈28% of total seafood consumption per year. Small-pelagic species (e.g., round scad, sardines) landed in the Philippines remain largely in country, with additional imports of round scad recently undertaken by DA-BFAR to reduce rising market prices driven by a lack of supply and thus support food security. Due to their lower relative market cost compared to large pelagics and reef fishes, small-pelagics and canned fish are an important food source for lower income deciles of the population. As such, declines of small pelagic stocks or reduction in canned fish (e.g., tuna, mackerel, sardine) availability could potentially result in damaging impacts in terms of income and nutrition. To that end, the cumulative fishing effort currently directed towards small pelagic stocks is likely too high, with signs of localised depletion long evident for several species. Moreover, there is mixed evidence as to whether the various closed seasons imposed to protect small pelagic stocks during spawning is an effective stock management measure. As discussed in previous chapters, spatial information on catch paired with a better understanding of stock structure is required to properly determine stock status and design effective management measures. Indeed, the effective management of pelagic stocks in the Philippines is becoming increasingly important, given that the commercial sector almost exclusively targets pelagic species and municipal fishers are becoming more dependent on the catch of pelagics, particularly in urban areas, due to the ongoing decline of demersal fish stocks. A similar trend has been documented in the Solomon Islands (Malaita), whereby local fishers largely switched from targeting the overfished reef-fish stocks to the more productive and resilient sardine fishery in the lagoon

[28] While we term these taxonomic groups 'pelagic' based on their ecology and due to a lack of species-specific landings data, it should be acknowledged species within these groups (e.g., *Selar crumenophthalmus, Decapterus macrosoma, Decapterus punctatus*) are in fact reef associated species, as per studies from the peer reviewed literature (Geronimo & Cabral, 2014; Newton et al., 2007) and fishery management plans (WPRFMC, 2001).

(Roeger et al., 2016). In that study, the authors concluded that 'fishing down the food chain' from reef fish to sardines paradoxically increased food security (Roeger et al., 2016). While we are not suggesting that the same increase in food security would necessarily occur in the Philippines if municipal fishers were to largely switch to targeting pelagic species in future years, given that pelagic stocks are not immune to overexploitation and the fishing pressure on these stocks in the Philippines is far greater than in the Solomons, determining future food security based on temporal trends in catch and consumption is certainly an avenue for further research.

In the Philippine context however, despite the nutritional benefits associated with the greater consumption of fresh fish in southern regions, including high consumption of round scad and frigate tuna, southern regions have higher prevalence of food insecurity and underweight and stunting among children and adolescents relative to northern regions that consume lower amounts of seafood. For these reasons, while seafood consumption in southern regions appears critically important in supporting the current level of food security, the role of other high energy foods such as rice and vegetables appear similarly influential. By assessing whether nutrient intakes from seafood consumption meet the minimum dietary requirements of individuals and households, future studies may be able to tease apart the role of seafood from other food groups in determining food security and elucidate the degree to which seafood consumption, or the consumption of particular species, would need to increase in southern regions to bolster food security.

Given that food security can only be achieved at a national level by providing food to those most food insecure, two underestimated and likely underappreciated resources are 1) coral-reef fishes caught by municipal fishers, particularly in remote locations, and 2) invertebrates gleaned from the intertidal zone. As described throughout previous chapters, municipal landings are almost certainly underestimated and neither DA-BFAR nor DOST-FNRI survey the most remote locations where the contribution of reef fishes to food security is likely greater, given the healthier status and greater catches of reef fish in these areas. With regards to gleaners, data on catch at a regional and national level is severely lacking (Palomares & Pauly, 2014) but the benefits are clear at the local level; gleaning provides high-quality seafood for subsistence, offers alternative or extra income, can be performed with very little to no capital, is often the easiest food provision option of poor coastal families, and is carried out mostly by women (and to some extent by men and children) in contrast to Philippine capture fisheries which are generally male dominated (De Guzman et al., 2016, 2019). To gain a proper appreciation for these resources in terms of food security and livelihoods, independent studies on the catch and consumption of reef fishes within communities in remote locations and of gleaners throughout the country should be considered.

More generally, Philippine coral reefs have been historically undervalued for their contribution to food security and livelihoods. The 15 km band of coastline dotted with coral reefs and accessible to municipal fishers currently supports 50 times more employment than the remainder of the EEZ fished by the commercial sector, notwithstanding the significant but undocumented downstream employment of the municipal fishing sector (i.e., local landing sites, markets, etc.). Moreover, despite the overexploited nature of most stocks, demersal fishes remain an important component of municipal catches, comprising around 54% of municipal catch composition (Muallil et al., 2014). Coral reef ecosystems of the Philippines also support various life-stages of reef-associated pelagic species which are important for fisher livelihoods and domestic consumption, such as round scad and big-eyed scad. Coral reefs therefore offer substantial benefits in terms of fisher livelihoods and food security. Additionally, coral reefs of the Philippines provide a number of other ecosystem services (e.g., the transport of nutrients and minerals, regulation of food web dynamics, linkages between other ecosystems – both land and marine, etc.) and contribute significantly to tourism, an industry which can provide a means of alternative livelihood for municipal fishers and thereby reduce fishing pressure on overexploited stocks (although see Fabinyi, 2010).

The numerous benefits of Philippine coral reefs should also be framed with the perspective that currently reefs are of poor health, with 86% of reefs outside of marine protected areas being classified as overfished and 14% of the remaining reefs being classified as fully fished (Muallil et al., 2019). In addition, it is estimated that ≈74% of Philippine reefs have relatively low levels of hard coral cover (<33%) and low to moderate coral diversity (<22 coral categories surveyed) (Licuanan et al., 2019). Effective management which increases reef ecosystem and fish stock health would therefore almost certainly boost the already substantial benefit of coral reefs to fisher livelihoods and food security. Nevertheless, when compared to the substantial government assistance and foreign aid historically directed towards the development of aquaculture and the pursuit of valuable foreign export markets supplied by a highly efficient commercial fleet, the management of coral reefs in the Philippines has been proportionately inadequate and mostly NGO-driven. There remains a need to refocus government support on coral reef ecosystems which ensure reliable fish production and secure livelihoods for the majority of stakeholders, municipal fishers.

5.1 Key Threats to Fish in Nutrition Systems in the Philippines

While a range of a threats to the ongoing contribution of fish in nutrition systems of the Philippines have been identified and well described in the peer-reviewed literature (e.g., pollution, destructive fishing gear and practices, IUU fishing), three key risks stand out based on research for this study:

1. ongoing declines in fish availability resulting from ineffective fisheries management;
2. limited availability of some species important for domestic consumption as a result of large-scale exports; and
3. the impacts of climate change on ecosystems, fishers, and coastal communities.

5.1.1 Ineffective fisheries management

As evident throughout this report, fisheries management to date has been ineffective at reducing overcapacity, rebuilding overexploited fish stocks, and improving the income, employment, and food security of Filipinos. Consequently, the future of fish in nutrition systems will depend heavily on the will of management agencies and the political system to implement effective management measures and their ability to educate coastal communities on the importance and benefits of resource stewardship. In the Philippine context, in addition to political will, the main impediments to stronger fisheries management are limitations on capacity, both financial and human. Secondly, while some LGUs have demonstrated they are capable of implementing resource management initiatives, many lack the technical capacity, support for enforcement, financial aid, and/or sufficient data to understand the state of their marine resources. While ensuring LGUs have the resources and capacity to understand and implement fisheries management is important, given the poor state of fish stocks across the country there is a clear need for the management of fisheries at scales above the community level. This has been long recognised by DA-BFAR, as evident in the issuance of Fisheries Office Order no. 217, *Adoption and Implementation of the Integrated Fisheries Management Unit (IFMU) Scheme* in 2008, and Fisheries Administrative Order no. 263 *Establishment* *of Fishery Management Areas (FMAs) for the conservation and Management of Fisheries in Philippine Waters* in 2019. Nevertheless, given the lack of understanding around catch, effort, and the biology of targeted stocks and their habitats in the Philippines, the scale of effective management remains unclear. While the recently implemented FMAs were reportedly designed to consider the boundary, range, and distribution of targeted stocks based on reports of the NSAP and "Other scientific information", the degree to which these actually reflect stock structure of key fishery target species is uncertain. Notably, the NSAP only collects length-based biological information for targeted species, which are inadequate to determine stock structure, and independent studies from the peer reviewed literature that infer stock boundaries based on genetic analysis or otolith morphometrics do not appear to align with boundaries of Philippine FMAs (e.g., Abesamis et al., 2017; Ackiss et al., 2013; Cabasan et al., 2021). There is also a notable lack of stock structure information for key fishery targets in the peer reviewed literature (e.g., round scad, frigate tuna, big-eyed scad), which one would consider should be a key determinant of FMA boundaries given their contribution to catch, livelihoods, and nutrition. Without such information, it remains unclear at what scale LGUs should work together to conserve their marine resources and the extent to which reference points, which are to be designed by FMA scientific groups, will be reliable or effective.

Nevertheless, the application of FMAs may provide a useful administrative framework for the management of fisheries as new information on stock structure becomes available over time. The Philippines FMA system has conceptual similarities to the framework of Fisheries Management Areas (FMAs) established in New Zealand to underpin the Quota Management System (QMS). Under that framework, New Zealand's EEZ is divided up into 10 FMAs. These FMAs are 'bolted together' as required for management purposes based on the stock structure of each species. For example, two intermixing stocks of hoki are thought to exist in the New Zealand EEZ – in that case, nine of the 10 FMAs are combined into a single hoki Quota Management Area (with catch in the remaining area negligible). By contrast, biological information suggests multiple independent stocks on ling exist throughout the New Zealand EEZ, with the species managed according to eight separate QMAs (with separate TACs set for each). A similar scenario would almost certainly occur across Philippine FMAs if data were available to determine stock boundaries. Ultimately, while we acknowledge that splitting the Philippine EEZ into smaller FMAs may allow for better control of fishing mortality and compliance operations, indices used to determine stock status will be inherently unreliable without an understanding of stock structure. For this reason, the Philippines should aim to manage its key target species at the biological stock scale over the medium term. In the short-term however, the need to reduce fishing mortality of stocks important for food security is clear and it is likely that management reference directions informed via a range of qualitative (e.g., key-informant interviews/ focus groups, use of fisher's traditional knowledge) and semi-quantitative assessments (e.g., surplus-yield models or yield-per-recruit analyses, albeit both models tend to provide over-optimistic results) will be an adequate basis for management action at the FMA level.

Once the management reference direction has been agreed, one must then decide upon management measures which are implementable given political, economic, social, and technical constraints. Given the low capacity and limited political will to implement and enforce fisheries management measures in the Philippines, our view is that imposing buy-back schemes, limited entry, and/or year-round catch restrictions is unlikely to work in practice and will impose further financial and nutritional stress on municipal fishers whose catches have already declined through time due to ineffective fisheries management. For example, DA-BFAR has noted that poor compliance of fishers with the small-pelagic closed season that used to extend for 4 months was caused by the longer period (Bagsit, 2020), resulting in the 2013 decision to shorten the closed season period in the Visayan Sea to 3 months (November 15 to February 15). Accordingly, implementing short-term closed seasons (known as seasonal fishery closures in the Philippines), temporary or spatially limited gear restrictions in areas deemed important for spawning/recruitment, and/or minimum size limits for species that are important for domestic consumption likely offer greater chance of succeeding in practice.

When fully implemented, the new regulations on Vessel Monitoring by DA-BFAR will offer significant improvements in the state of commercial fisheries catch data in the Philippines. These regulations require commercial vessels to implement Vessel Monitoring Systems (VMS), which must transmit location information to DA-BFAR every hour, and vessels must also submit an electronic catch report which include details on the species and volume of fish caught, the location where they were caught, the port of origin and arrival, and information on vessel activity. However, commercial fishers comprise a small minority of fishers in the Philippines. Catch and effort data currently collected for the larger municipal sector are unreliable and insufficient to assess stock status or determine effective management reference points. As such, there remains a need to improve the data collected for the municipal sector, particularly for species deemed important for nutrition by the present study, so that effective management strategies can be designed and implemented. Simple data, such as the collection of catch location information during the existing DA-BFAR surveys, would improve our understanding of stock specific exploitation considerably. The ideal situation would be that DA-BFAR also expand their survey of municipal fisher catches to areas away from major fish landing ports and to remote regions where municipal landings are likely to comprise a different species assemblage. We also note that the NSAP has significant potential to improve biological information on targeted stocks which are important for consumption by simply collecting a subsample of otoliths, fin clips, and gonads of key fishery target species during their existing sampling program. Such samples would allow for the derivation of genetic and age-based biological information critical for determining stock boundaries and biological rates important for management (e.g., growth, maturation, and mortality rates). As mentioned previously, the limiting factor to the collection, processing, and interpretation of biological samples is likely adequate funding. However, given the importance of this information for stock management and the substantial revenues made by commercial fishers (14.26 billion PhP after immediate expenses in 2017 alone[29]) who disproportionately benefit from harvesting, we suggest such funding could be fairly derived from increasing the licence fees of commercial vessels to better recover some costs of management (annual licence fees currently range from 200-2,500 PhP + 2-4 PhP/tonne or a fraction thereof, depending on vessel size).

5.1.2 Overcommitment of commercial landings to foreign export markets

In 2019, the Philippines fishery sector exported 264,254 t of seafood worth 1,125 million US dollars (DA-BFAR, 2020a). These exports included fish important for nutrition, specifically tuna and in lesser proportions round scad, bigeye scad, and sardines. Given the importance of canned fish for domestic consumption, particularly among poor, rural, food-insecure consumers, the Philippines has important policy decisions to make around the proportion of nutritionally important species it allows

[29] 2017 *Annual Survey of Philippine Business and Industry*

to be exported versus retaining the fish in country to support domestic consumption. While dated, Yamashita (2008) estimated that only around 10% of canned tuna production in the Philippines enters the domestic market. From a nutrition/livelihoods point of view, the lack of tuna retention for domestic consumption is particularly worrisome given municipal and commercial sectors compete over the same tuna stocks. Thus, despite the spatial separation of these sectors, domestic commercial catches are potentially depleting municipal catch with little relative benefit in terms of employment or food security to the wider population. While we are certainly not advocating for Philippine canned tuna exports to cease, we note that the Philippines Fisheries Code of 1998 explicitly mentions that exports are to be managed to not negatively impact domestic food production. Tuna, both canned and fresh, is commonly consumed and remains one of the best fish in terms of nutritional composition. As such, policies which aim to ensure an appropriate balance of exports vs retention for domestic consumption in the context of food security should be considered. Such policies are currently being discussed among other Pacific nations, with the aim to increase the domestic supply of tuna in FFA member countries by 40,000 t by 2024 to provide nutritious food and reduce pressure on inshore resources (FFA and SPC, 2015). Indeed, there are several FFA member countries who have already implemented public governance instruments that link fisheries and aquaculture with Food and Nutrition Security (e.g, Samoa, Vanuatu, Tonga; Farmery et al. 2021). Lessons learned in the Pacific may therefore provide useful information in terms of retention policies.

5.1.3 Concomitant impacts of climate change.

Climate change and concomitant effects on the frequency and severity of disturbance events is becoming increasingly important in driving ecosystems and fish stocks globally. The Philippines is not immune to such changes. Among fishing nations, the Philippines is considered one of the most vulnerable countries to climate change (Badjeck et al., 2010; FAO, 2016), with several studies already reporting an increase in temperature on the Philippines seas (Geronimo, 2018; Hoegh-Guldberg et al., 2017; Khalil et al., 2016; Peñaflor et al., 2009). The Philippines has also been ranked third in terms of vulnerability to climate change risks among 67 developed, emerging, and frontier market countries, and is considered particularly sensitive to the impacts of environmental disturbance events (Paun et al., 2018). In particular, climate change is predicted to exacerbate the plight of the poor in the Philippines, due to their lower capacity to adapt to potential risks (World Bank, 2018). This is particularly true for poor households in the north of the country which derive most of their income from fishing, as the number of fishing days will almost certainly be limited by increased frequency of disturbance events (e.g., typhoons), with flow-on effects to fishers and fish consumption among these communities (Holden & Marshall, 2018). The increasing severity of storms and typhoons is also likely to result in greater damage to properties, fishing gears, and aquaculture operations, thereby worsening the incidence of poverty among the population, particularly among the already poorest-of-the-poor small-scale fishers. Recent studies have also shown that the warming of the ocean can cause the poleward migration of pelagic fishes thereby considerably reducing fish stocks along the tropics, such as the Philippines (Chaudhary et al., 2021). Warming of the ocean will also result in more frequent mass coral bleaching events, which are detrimental to coral reef ecosystems and fisheries, and compound upon the negative effects of destructive fishing practices, ocean acidification, and pollution. Given the increasing risk posed by climate change, the development of effective fisheries management in the country, particularly for stocks deemed important for consumption, is paramount.

5.2 Data gaps and caveats

The importance of municipal fishing for food security and livelihoods in the Philippines, reflects the general significance of this sector throughout the Pacific where 10–20 times more people fish for subsistence than for commercial purposes (Asian Development Bank, 2014a; Gillett, 2009). Nevertheless, data on fisheries participation in the Philippines is inconsistently collected and often contradictory. This makes it difficult to accurately quantify and appreciate the socioeconomic benefits of each fishery sector and target species to Filipinos. More importantly, information on fisheries-related employment is critical for fisheries management, not only to derive effort information but also to determine how management decisions will impact fishers and in turn fishery-related workers and their families. The lack of adequate data on fishery employment has previously resulted in significant debate surrounding the impact of management decisions in several fisheries in the Indo-pacific region, including trochus (Fiji), beche-de-mer (Solomon Islands), spearfishing (Fiji), night scuba diving (American Samoa), giant clams (Tonga), and export of reef fish (Palau) (Gillett, 2016). The lack of reliable and regular estimates of employment in the various fisheries sectors remains a significant knowledge gap and an impediment to effective fisheries management in the Philippines.

Similarly, landings data collected for commercial and municipal fishery sectors is insufficient for management purposes. Surveys used to estimate landings data for both sectors occur through port-based sampling of a relatively low number of operators in a small number of fishing ports, resulting in substantial underestimation of actual catch. Underestimation of gross landed catch and mis-categorisation of catch composition is a particular problem for the municipal sector as catch is often landed away from major landing sites/ ports and/or kept for subsistence. It is also evident that the current port-based sampling protocol does not record the area in which landings were caught, which confounds the use of landings data for stock assessment and management purposes. In the absence of reliable catch data, the NSAP has attempted to provide some stock information at a regional scale, but it is evident that significant investment in the NSAP or similar programmes are required to gather age-based information on targeted stocks, specifically those important for domestic consumption, in order to render informed management decisions.

As mentioned previously, there is a lack of data on the catch of gleaners and in-turn the contribution of this catch to food security. Documenting such information remains a research gap, particularly given the likely importance of gleaning for food security among poor fishing households (De Guzman et al., 2016, 2019) .

Finally, the 2018-19 DOST-FNRI ENNS did not differentiate species of canned fish from one another which confounded our understanding of which species are ultimately important for consumption. This was due, in-part, to the limited types of canned fish included in the Philippine Food Composition Tables (FCT). While updating the FCT according to canned fish species would be ideal, simply differentiating canned fish consumed by taxonomic group (i.e., tuna, sardines, mackerel) would allow future nutrition surveys to improve our understanding of which taxonomic groups contribute more to food security.

5.3 Conclusion

This study provides the first detailed assessment of the importance of the various fishery sectors and target species for food security in the Philippines. We also consolidate information from the existing literature on the role of the various fishing sectors in supporting the livelihoods of fishers and downstream workers. This information has been presented at both a national and regional level and the results will hopefully provide useful information to Oceana, LGUs, and DA-BFAR to prioritise the management of those species most important for domestic consumption and food security. To that end, we recommend that a technical working group comprising representatives of the responsible government departments (e.g., DA-BFAR, DOST-FNRI), key LGUs, relevant NGOs (e.g., Oceana), and independent experts be established to examine implications of the present study in terms of management programs for stocks deemed important for food security. There is also significant opportunity to optimise individuals' diets for nutritional outcomes of fish consumption, rather than simply the weight of consumption. If managed strategically, nutrition-based policies and landings from Philippine fisheries could sustainably enhance the diet quality of millions of people and increase the incidence of food security among the population, particularly in locations where people have access to fish but inadequate nutrient intakes.

6 References

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Annex 1 – Terms of Reference for the Project

Oceana Request for Proposals: State of Fish in Nutrition Systems in the Philippines

Oceana is seeking a consultant(s) to provide an analysis of the most important domestic, marine capture fisheries in the Philippines in terms of their contributions to domestic livelihoods and domestic seafood consumption overlayed with a landscape of poverty, hunger, and food insecurity by region and anticipated risks to the identified fisheries or food systems.

Oceana is a campaign-based advocacy group focused on changing fisheries policy at the national or regional government level. Oceana currently has offices in Belize, Brazil, Canada, Chile, the European Union, Mexico, Peru, the Philippines, the United Kingdom, and the United States. Oceana's campaign approach in these countries includes five basic elements: science, law, media, policy work, and public pressure. Oceana's campaigns in each country emphasize improvements in national fisheries management via science- based limits on fish catches, bycatch reduction, protection for critical fish habitat, and increased transparency in decision-making and monitoring.

This research will support Oceana's investigation into the research linkages between healthy fisheries and healthy communities to identify current and future campaign activities most important for livelihoods or domestic food production in vulnerable populations in the Philippines.

Applicants should have demonstrated knowledge of marine policy, food security, and poverty and experience in scientific research and synthesizing technical information for non-technical audiences. The ideal candidate lives or has prior work experience in the Philippines.

Scope of Work

We anticipate this research will be conducted using peer-reviewed literature, government white papers, unpublished documents from industry and nonprofits, custom and trade databases, and other sources. We encourage the use of expert interviews and request

that full transcripts of these interviews be sent to Oceana in confidence, except under unusual circumstances to be discussed in advance of the interviews. Information linked to all original sources, including names, will not be released publicly. Final reports must be clear, in the consultant's own words, and provide a comprehensive summary of the scopes of work presented below. Oceana has staff in Manila available for consultation, by request, and context setting landings and trade research that can be provided to the consultant.

The goal of this project will be to identify the major domestic, marine capture fisheries in the Philippines in terms of their overall and intra-annual (e.g. seasonal, if available) contribution to food security through impacts on fisheries-related food provisioning (direct consumption of fish and seafood) and livelihoods (employment and income). Information supporting these determinations should be supported by a synthesized research report and an organized spreadsheet of all supporting data. In addition, analysis should provide an overview of poverty and food insecurity, by region where possible, and anticipated risks from climate change, trade, and/or overfishing to identified fisheries or domestic food systems (e.g. climate change impacts could increase storms and decrease number of fishing days in fishing communities without refrigeration or storage capacity, limiting their daily livelihoods and/or fish access in markets).

1. Socioeconomic Status

The goal of this scope of work is to provide additional socioeconomic context to the identified most important fisheries in the Philippines. Provide an overview of socioeconomic and geographic patterns related to income levels and food and nutrition security, by region where possible. Include national and sub-national statistics and analysis on malnutrition and access to nutritious food. Note where risks are anticipated to the identified fisheries or domestic food systems. More specific questions for this scope of work are provided below:

- Demographic Characteristics
    - What are the general socioeconomic patterns or divisions in the population?
    - What geographic or regional patterns exist for domestic fish and seafood consumption? Are there clear divides among the population, e.g. by island?
    - What socioeconomic patterns exist for domestic fish and seafood consumption? Are there clear urban-rural or coastal-inland divides among the population?
- Food and Nutrition Security Characteristics
    - What are the levels of malnutrition in the overall population and by geographic or regional divisions?
    - Are there coastal communities at relatively high risks of food insecurity?
    - Do coastal communities have adequate access to nutritious food, in terms of market access, affordability, utilization (e.g. cultural norms), and stability of food systems.

2. Fisheries Employment and Income

The goal of this scope of work is to evaluate the top domestic, marine capture fisheries in the Philippines based on their impact on livelihoods. In this instance, the evaluation of livelihoods should focus on employment and income to those engaged in fish-related activities (e.g. harvesting, processing, selling). Where possible, Oceana is also interesting in understanding how this evaluation varies by fishing fleet type (e.g. small-scale vs. large- scale, artisanal vs. industrial), region, season (i.e. is fishing year-round or seasonal), and formality of the sector. More specific questions for this scope of work are provided below:

- Top Fisheries by Employment
    - What are the top fisheries based on the total number of people employed?
    - What types of employment in fish-related activities does each fishery support? Which activity provides the most employment for each fishery?
    - For each fishery, how does employment vary by type of fishing fleet? Which type of fleet is the source of the most employment?
- Top Fisheries by Income
    - What are the top fisheries based on total income generated?
    - What are the top fisheries based on per-employee income?
    - For each fishery, how does per-employee income vary by the type of fish- related activity? Which type of activity provides the highest per-employee incomes?
    - For each fishery, how does per-employee income vary by type of fishing fleet? Which type of fleet provides the highest per-employee incomes?

- Fisheries Contribution to Livelihoods and/or Food Security
    - What are the informal fisheries with high levels of participation or reliance for subsistence?
    - Is seasonality an issue with access to fishing, e.g. certain fisheries are only open during specific seasons vs. year-round?
    - How does fishing fit into overall livelihoods, i.e. is fishing considered a temporary occupation when employment is scarce, is it used to provide fish for household consumption as needed, etc.?

This work will likely rely on literature reviews, data requests to government statistics/fisheries departments, and possibly interviews with the government or private sector. When relevant, compare findings from these data with international datasets (e.g. FAO, World Bank).

3. Domestic Fish Consumption

The goal of this scope of work is to evaluate the top domestic, marine capture fisheries in the Philippines based on their direct contributions to domestic seafood consumption, as well as the relative contributions of other sources of seafood (e.g. aquaculture, inland capture, foreign). To the extent possible, this research should also consider the socioeconomic context and the consumers relying on those fisheries. More specific questions for this scope of work are provided below:

- Top Fisheries by Domestic Consumption
    - What fisheries are most important for domestic consumption of fish and seafood? What is the source and type of these fisheries (e.g. domestic, foreign, aquaculture, marine capture, inland capture)?
    - Which domestic, marine capture fisheries are most important for domestic consumption of fish and seafood?
    - Who are the main domestic consumers? Where are they located?

- Consumption Patterns
    - Has domestic consumption of the top fisheries changed over time?
    - How does domestic consumption of each of the top fisheries change seasonally?
    - Are there fish species that were historically popular that are no longer plentiful enough to consume today? Are there fisheries that are currently plentiful but appear unpopular for domestic consumption?
    - What are the main substitution patterns between fish species by domestic consumers?
    - What is the primary driver of domestic consumption of the top fisheries (e.g. affordability, desirability)?

The consultant should compare results from the following suggested paths of research to ensure an informed analysis. However, Oceana is open to discussing alternative research methods.

- Oceana can provide estimates of catch remaining in-country for domestic consumption by the local population, based on a global seafood trade database incorporating data on landings, exports, and catch by foreign vessels.

- Review polls, surveys, and other field studies on domestic food consumption.

This scope of work should include an output of two lists: (1) of all fisheries (foreign, domestic, marine capture, aquaculture, inland capture, etc.) ranked by per capita consumption (kilograms per person per year) in-country, and (2) of only domestic, marine capture fisheries ranked by per capita consumption (kilograms per person per year) in- country. If quantitative results are unavailable, a ranked list with qualitative results would be acceptable. If data are insufficient for identifying the most important domestic

fisheries for domestic consumption, the consultant should develop recommendations for the best way of determining this information.

4. Critical Analysis

The goal of this scope of work is for the consultant to provide a discussion, based on their research of the components above and their expertise, as to the most important marine capture fisheries for people in the Philippines. This report should provide a discussion of the country's socioeconomic conditions with a focus on whether the populations producing and consuming fish and seafood align with those most vulnerable to food insecurity.

The discussion should also include caveats and assumptions of the analytical approach as well as suggestions for future research projects to address these shortfalls. For example, the consultant could provide context as to how the results of the analysis would change if it were to focus on nutritional benefits instead of weight of consumption.

Annex 2 – Sample Sizes of DOST-FNRI 2018-19 ENNS

Year	Region	Location	Number of individuals surveyed	Number of households surveyed
2018	CAR	ABRA	2467	654
2018	CAR	BAGUIO CITY	1131	264
2019	CAR	BENGUET (EXCLUDING BAGUIO CITY)	1750	473
2019	CAR	KALINGA	2646	633
2018	CAR	MOUNTAIN PROVINCE	2165	599
2018	NCR	CALOOCAN CITY	2797	335
2018	NCR	CITY OF LAS PINAS	1278	341
2018	NCR	CITY OF MAKATI	824	234
2019	NCR	CITY OF MALABON	1090	316
2018	NCR	CITY OF MANDALUYONG	982	234
2018	NCR	CITY OF MANILA	1459	402
2019	NCR	CITY OF MARIKINA	1062	250
2019	NCR	CITY OF PARAÑAQUE	432	103
2018	NCR	CITY OF SAN JUAN	399	114
2018	NCR	CITY OF TAGUIG	1225	368
2019	NCR	PATEROS	488	134
2018	NCR	QUEZON CITY	1231	298
2019	REGION I	ILOCOS NORTE	2373	646
2019	REGION I	PANGASINAN	2482	612
2018	REGION II	CAGAYAN VALLEY	2357	647
2018	REGION II	ISABELA	2576	661
2018	REGION II	ISLABELA CITY	712	174
2018	REGION II	NUEVA VIZCAYA	2108	557
2019	REGION II	QUIRINO	2373	671
2018	REGION III	BULACAN	1737	441
2019	REGION III	NUEVA ECIJA	2101	558
2018	REGION III	OLONGAPO CITY	1069	274
2019	REGION III	PAMPANGA (ANGELES CITY)	1342	288
2019	REGION III	PAMPANGA (EXCLUDING ANGELES CITY)	1850	460
2018	REGION III	ZAMBALES	2349	579
2018	REGION IV-A	LAGUNA	1953	505
2019	REGION IV-A	QUEZON (EXCLUDING LUCENA CITY)	2104	594
2019	REGION IV-A	RIZAL	1504	385
2019	REGION IV-B	MARINDUQUE	2338	646
2018	REGION IV-B	ORIENTAL MINDORO	2475	626
2019	REGION IV-B	PALAWAN - PUERTO PRINCESA CITY (CAPITAL)	1723	434
2019	REGION IV-B	PALAWAN (EXCLUDING PUERTO PRINCESA CITY)	2529	619
2018	REGION V	CAMARINES NORTE	1418	677
2019	REGION V	CAMARINES SUR	2401	611
2018	REGION V	SORSOGON	3056	688

2018	REGION VI	AKLAN	2228	642
2019	REGION VI	ANTIQUE	2027	562
2018	REGION VI	CAPIZ	2482	684
2019	REGION VI	GUIMARAS	1118	321
2018	REGION VI	ILOILO CITY (Capital)	2520	604
2018	REGION VI	ILOILO PROVINCE	2339	693
2019	REGION VII	CEBU - LAPU-LAPU CITY (OPON)	1772	441
2019	REGION VII	CEBU (EXCLUDING HUCS)	2556	666
2018	REGION VII	MANDAUE CITY	1713	440
2018	REGION VII	SIQUIJOR	1307	362
2019	REGION VIII	BILIRAN	2604	664
2018	REGION VIII	EASTERN SAMAR	2938	705
2018	REGION VIII	NORTHERN SAMAR	3186	716
2019	REGION VIII	SOUTHERN LEYTE	2671	707
2018	REGION VIII	TACLOBAN CITY (Capital)	2446	554
2018	REGION VIII	WESTERN SAMAR	2999	654
2018	REGION IX	ZAMBOANGA DEL NORTE	2252	558
2019	REGION IX	ZAMBOANGA DEL SUR	2507	665
2019	REGION IX	ZAMBOANGA DEL SUR - ZAMBOANGA CITY	2013	484
2019	REGION IX	ZAMBOANGA SIBUGAY	2652	649
2019	REGION X	BUKIDNON	2516	597
2018	REGION X	CAGAYAN DE ORO CITY (Capital)	1622	447
2018	REGION X	CAMIGUIN	1297	355
2019	REGION X	LANAO DEL NORTE (EXCLUDING ILIGAN CITY)	3270	732
2019	REGION X	MISAMIS OCCIDENTAL	2696	692
2018	REGION XI	DAVAO CITY	1682	504
2019	REGION XI	DAVAO DEL NORTE	2357	614
2018	REGION XI	DAVAO OCCIDENTAL	2527	710
2019	REGION XI	DAVAO ORIENTAL	2515	651
2019	REGION XII	MISAMIS ORIENTAL (EXCLUDING CAGAYAN DE ORO CITY)	2639	651
2019	REGION XII	SOUTH COTABATO (EXCLUDING GENERAL SANTOS CITY)	2325	573
2018	REGION XII	SULTAN KUDARAT	2630	628
2019	REGION XIII	AGUSAN DEL NORTE (EXCLUDING BUTUAN CITY)	2833	688
2018	REGION XIII	BUTUAN CITY (Capital)	2174	568
2019	REGION XIII	DINAGAT ISLANDS	1459	368
2019	REGION XIII	SURIGAO DEL SUR	2408	663
2019	BARMM	BASILAN	2800	608
2019	BARMM	LANAO DEL SUR	3568	644
2018	BARMM	MAGUINDANAO	3231	635

Annex 3 – Species included in DOST-FNRI “other fresh fish and cooked fish recipes” and “other processed fish” categories

Species/ species groups included in “Other Fresh fish and cooked fish recipes” category.

FOODNAME	ALTERNATE OR COMMON NAME
Amber fish	Tonto
Anchovy, Indian (adult)	Tuakang
Barracuda, striped	Turcillo
Butterfly fish, threadfin	Paru-paro
Cardinal fish	Dangat/ Langaray-laot
Carp	Karpa
Catfish, freshwater	Hito
Catfish, saltwater	Kanduli
Cavalla, banded	Talakitok/Maliputo
Cavalla, banded, fried	Talakitok, prito
Cavalla, banded, steamed	Talakitok, pinasingawan
Climbing perch, common	Martiniko
Croaker, tigertooth	Abo
Croaker, plain	Alakaak/Croaker, truncate-tail
Croaker, smooth-scaled whiskered	Johnius dussumieri
Drepane, speckled	Mayang
Eel, silver pike	Pindanga
Eel, swamp	Palos
Flatfish/Brill, rough-scaled	Dapa
Flatfish/Brill, smooth-scaled	Dapang bilog
Flatfish/Turbot, indian	Kalangkaw
Flathead, indian	Sunog
Flying fish	Bulador/Borador
Garfish, common	Kambabalo/Hound needlefish
Gizzard shad, short-finned	Kabasi/Chacunda gizzard shad
Goatfish, ochrebanded	Saramulyete
Goby, flat-headed	Biyang puti/ Tank goby
Goby, long-tailed	Talimusak
Gouramy	Gurami/Goramy
Halfbeak, long billed	Buguing
Hard-tail	Oriles
Herring, deep-bodied	Lapad/White sardinella
Lizard fish, common	Kalaso
Mojarra, longfin	Hubad
Mojarra, whipfin	Malakapas
Moonfish, spotted	Chabita
Moray	Malabanos
Mudfish/Murrel, striated	Dalag
Mudfish/Murrel, striated, boiled	Dalag, nilaga
Mullet, black-finned	Talilong/ Otomebora mullet
Mullet, large-scaled	Banak
Parrot fish, daisy	Isdang loro
Threadfish, indian	Damis/Diamond trevally
Silvergrunt, bluecheek	Bangok-ngok
Pomfret, black	Pampano

Bream, humpnose big-eye	Malaking mata
Emperor, pink ear	Bitilla
Seabream, goldsilk	Bakokong moro
Runner, rainbow	Salmon
Sardine, bombon	Tawilis/Freshwater sardinella
Sea bass	Apahap
Sea catfish, smooth-headed	Bunguan/Bongoan
Shark, gray (Carcharias sp)	Bagsak
Shark, hammerhead (Sphyma zygaena)	Binkungan
Shark, sharp-nosed (Scoliodon palasorrah)	Pating
Siganid, javan	Samaral/Streaked spinefoot
Silver-bar fish	Parang-parang/Dorab wolf-herring
Slipmouth, black-finned	Dalangat
Spadefish	Kitang/Spotted scat
Sting ray, blue-spotted	Dahonan/Dahunan
Sting ray, honeycomb	Paging, bulik
Surgeon fish, blue-lined	Labahita
Swordfish	Malasugi
Tarpon	Buwan-buwan
Ten-pounder, hawaiian	Bidbid/Hawaiian ladyfish
Therapon, convex-lined	Bagaong
Theraponid, silvery	Ayungin/Silver perch
Terapon, largescaled	Babansi
Threadfin fish	Mamale
Threadfin, fourfinger	Mamale
Threadfin, small-mouth	Mamaleng-bato
Whiting, common	Asohos
Whale, meat, raw	Balyena, laman includes: Dolphin/lumba-lumba, laman
Fish Cake, cooked	
Anchovy fry omelet, prep, w/ MLP	Dulong omelet w/ MLP
Red snapper fritata, prep, w/ MLP	Maya-maya torta w/ MLP
Fish, skin, fried, seasoned	Fish chicha ron
Fish, Bass, fresh water, mixed species, raw	includes: Tawis

Species/ products included in “Other Processed fish” category.

FOODNAME	ALTERNATE OR COMMON NAME
Bangus, sisig, can/ frozen	
Tuna, ham, processed	
Fish loaf, canned	
Tuna, chorizo	includes: Fish Chorizo
Tuna Tocino	includes: Fish Tocino
Fish stick, pattyr or nugget from restaurant, home, or other place	