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## Status of Fish in Food Security in Malaysia


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***Abstract***

*Food security has nowadays become a big challenge around the world. Therefore, this comprehensive review investigates the complex relationship between the status of fish resources and the escalating challenges posed by climate change and population expansion, focusing on Malaysia's food security. With the global population on the rise and the effects of climate change intensifying, it is of the utmost importance to ensure a consistent and reliable food supply. This review assesses the present status of Malaysia's fish resources as a crucial element of the nation's food security landscape by conducting a comprehensive literature review. By elucidating the intricate interplay between changing climate patterns, expanding population pressures, and the availability of fish fisheries, this study identifies future vulnerabilities and opportunities. The findings of this review demonstrate that increasing fish availability alone does not guarantee food security. Effective policies must instead take into account the complex interplay between various factors, including consumption behaviours and ecosystem resilience in order to promote sustainable food security in the face of changing challenges. The study highlights the need for a multidimensional approach that addresses not only sustainable production practises, but also habitat preservation, balanced utilisation, and adaptive management strategies. As the study concentrates on the Malaysian context, its implications extend to regions with comparable challenges, highlighting the urgency of adopting holistic governance models that integrate ecological health and food security objectives. This review provides valuable insights for policymakers, researchers, and stakeholders interested in formulating resilient and effective measures to ensure enduring food security amidst the ever-changing dynamics of climate change and population growth by developing strategy to improve the contribution of fish in terms of sustainable food supply in Malaysia.*



**Keywords:** *Fishing industry, Food security, Fish sustainability, Malaysia*


## 1. Introduction

Food security is a paramount global concern (Panghal et al., 2022) that is closely linked with the availability of protein-rich sources, notably fish, particularly in coastal-resource-rich nations like Malaysia. This Southeast Asian nation has a profound dependence on fish as a dietary staple, which has shaped its culture, nutrition, and economy. In accordance with the 1996 World Food Summit, food security is defined as the assurance that all people always have sufficient access to safe and nutritious food to satisfy the dietary requirements for an active and healthy life (World Bank, 2022). This assurance requires three crucial elements: the availability of sufficient sustenance, a steady supply, and easy access for those in need. Central to the concept of food security is the ability for every person to have both the physical and economic means to consistently acquire adequate nutrition.

Access to food, consumption, preparedness, and stability are the four pillars upon which food security is founded. In this context, fish products become an invaluable source of protein, vitamins, minerals, and micronutrients. According to the Department of Fisheries, Malaysia (2020), the Malaysian Fisheries Sector, encompassing aquaculture, capture fisheries, and inland fisheries, yielded a total of 1.85 million metric tonnes valued at USD 3.3 billion (RM 14.5 billion) in the year 2020. Malaysia's fish exports increased by an impressive 20.8% in 2019, totalling $649.18 million (Soh et al., 2022, 2021; Soh & Lim, 2020). Nonetheless, its ranking as the world's 39th biggest exporter of fish in 2019 reveals a striking disparity: since 2009, imports have significantly outpaced exports, resulting in a troubling trade deficit (see figure 1). According to Gould, Ruffin, and Anderson (1996), this sizable trade deficit is a cause for concern regarding a decline in global competitiveness. Therefore, Malaysia is more susceptible to price and volume risks due to its increasing reliance on imports for domestic fish supply threatening the stability of food security in the nation. As a result, the imperative objective of bolstering self-sufficiency in the fishing industry has acquired prominence, particularly for a nation recognised as the leading consumer of fish in Asia. A strategic shift towards increasing domestic production is significant because it mitigates the potential effects of international shocks, such as the global agricultural crisis of 2007-2008, which had repercussions in Malaysia. In spite of Malaysia's extensive fisheries subsidies, achieving sustainable fish production remains crucial in the face of these obstacles.

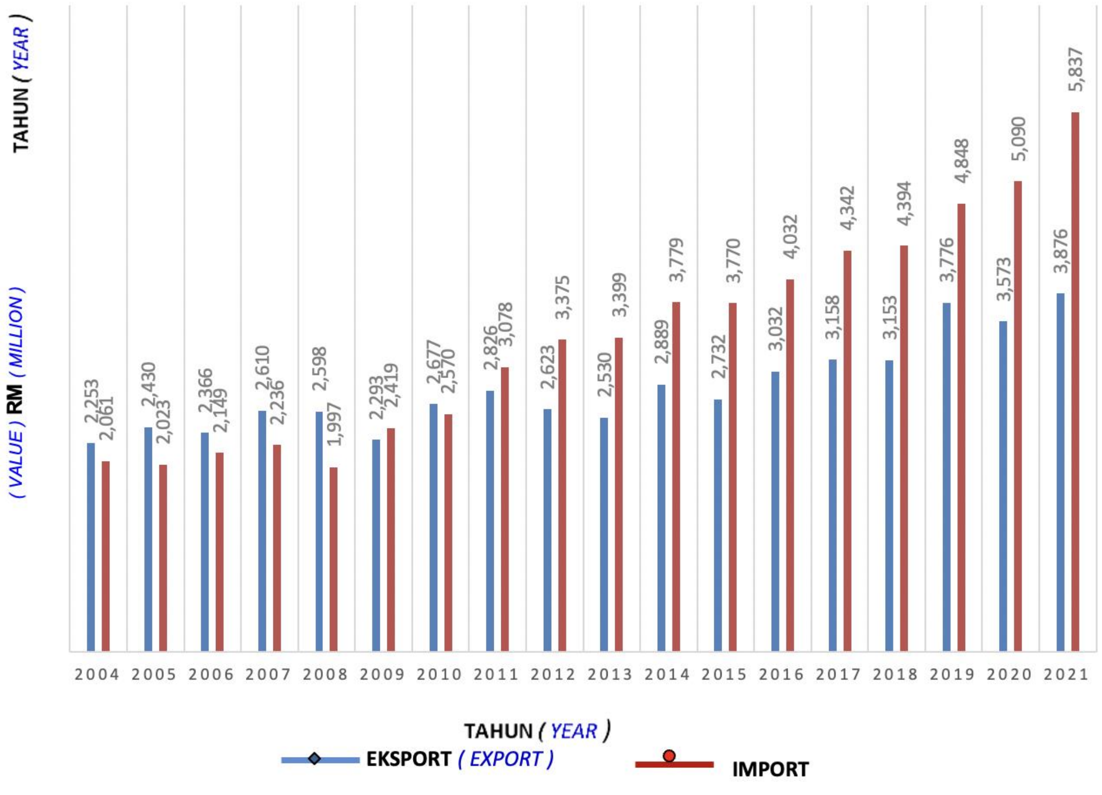


**Figure 1:** Value of Export and Import of Fishery Commodities, 2004 – 2021.
Source: DOF, Malaysia (2022)

On the other hand, the littoral and marine ecosystems of Malaysia, which are essential to the nation's food supply, are threatened by the escalating effects of climate change (Shaffril et al., 2017; Tang, 2019). The narrative of marine environments is being rewritten due to increased C02 emissions, sea temperatures, ocean acidification, rising sea levels, and altering precipitation patterns (Alam et al., 2015; Danylchuk et al., 2023; Suyani et al., 2023; Sharma, 2023; Yusuf et al., 2023). In this dynamic setting, fish habitats, migration patterns, and reproductive behaviours are subject to change, which may result in alterations in the allocation and richness of species. According to Ottersen et al. (2006), a decrease in fish populations caused by rising temperatures could impact fish migration patterns, egg incubation time, and spawning. Van der Lingen et al. (2016), on the other hand, affirmed that the frequency of deleterious algal blooms caused by dinoflagellates, which have a negative impact on fish species such as sardines, may be increasing due to climate change. Baker et al. (2008) also discovered that the fading and loss of coral reefs due to climate-induced ocean warming could result in the disappearance of particular marine species. Concurrently, the nation also struggles with the effects of accelerated population growth, particularly in urban areas. Urbanisation has influenced supply chains, trade networks, and consumer behaviour, in addition to dietary changes and an increase in demand for diverse protein sources, including fish (Population Pyramid, 2020). To ensure food security in the face of these dynamics, a comprehensive comprehension of the complex interplay between fish availability, resource management, and social factors is required.

In spite of these obstacles, the expanding fishing industry, which includes both capture and aquaculture, stands out as a beacon of hope. It has the potential to increase both the domestic fish supply and the contribution of the fishing industry to the national economy. Therefore, this exhaustive analysis addresses the issue of food security in Malaysia through the lens of its fish-related aspects. By elucidating these dynamics, this study will equip policymakers with strategic insights, allowing them to navigate the labyrinth of challenges and opportunities endemic to ensuring the sustainability of the nation's fish supply in the face of rising food demand.

## Status of Fishery Activity and Sustainability in Malaysia

### *Stock of Fish*

Malaysia's fishing industry has always played a crucial role in assuring food security and reducing hunger. This industry contributed 1.37 percent of the nation's gross domestic product in 2003 and employed 89,000 fishermen and 21,000 fish producers directly (Department of Fisheries, 2020). Predictions indicate that marine capture harvests will increase at a constant annual rate of 2.9%, from 1.32 million tonnes in 2010 to an estimated 1.76 million tonnes in 2020 (Yusoff, 2015). In 2012, 65 percent of the total yield came from coastal fishing, while the remaining 35 percent came from deep-sea fishing. Notably, it is anticipated that sea fishery catches will increase from 381,000 tonnes in 2012 to approximately 620,000 tonnes in 2020. Among these opportunities, deepwater trawling stands out as a particularly promising way to increase the nation's overall fish production. The National Agro-Food Policy (2011-2020) foresees that annual fish consumption will reach 1.93 million tonnes by 2020 as the population continues to expand and the demand for fish as a nutritious protein source increase (Yusoff, 2015).

Fish is an essential source of protein for Malaysian households and contributes to the nation's export earnings. This industry accounts for approximately one percent of Malaysia's gross domestic product, demonstrating its economic significance (Department of Fisheries Malaysia, 2020). The Department of Fisheries Malaysia projects that fish consumption will increase from 1.57 million metric tonnes in 2016 to an anticipated 1.9 million metric tonnes by 2020. It is crucial to note that fishing yields have plateaued in the face of escalating local and global food demands. This stagnation is attributable to overexploitation, habitat degradation, and pollution, all of which contribute to an unfavourable scenario.

Traditional fishing methods have resulted in the overexploitation of numerous fish stocks, with some even approaching extinction (Worm et al., 2009; Costello et al., 2012). In comparison to unfished counterparts, the selective targeting of species disrupts the population equilibrium of those species. As a result, the biomass of large fish, apex predators, and high-value species has declined significantly. Smaller fish and species with less commercial value have experienced comparatively minor population changes or even growth (Benoit & Swain, 2008; Richardson et al., 2009; Stone, 2010; Collette et al., 2011). Notably, species with higher fishing mortality rates and extended fishing histories have demonstrated greater rates of stock depletion (Pinsky et al., 2011). This trend emphasises the need for sustainable harvesting methods that prevent such disturbances.

In response, a collective ownership strategy for marine fisheries has been advocated. According to Gordon (1954), unrestricted fishing results in an oversupply that is economically unsustainable and detrimental to populations. Effective formal institutions, such as Total Allowable Catch (TAC) regulations, are required to prevent overexploitation and inefficiency (Hardin, 2019; Arnason, 2008; Arnason, 2008). In the absence of TAC regulations, fishery supplies may be jeopardised. In contrast, unrestricted implementation of TACs could lead to a competitive race among fishermen, with each attempting to maximise their allotted TAC portion (Birkenbach et al., 2017).

Establishing capture quotas through TACs typically functions to moderate fishing competition. In addition, it encourages a more strategic approach to pursuing species with a broader market relevance. Slow trawling velocities are consistent with this strategy, promoting the long-term viability of species by allowing for a longer period of economical supply (Homans & Wilen, 2005). Grafton (1996) argues that individual transferable quotas (ITQs) that allow permit holders to divide, trade, and own quotas in perpetuity are aligned with permit owners' interests, as increased fish stocks result in higher income. This system also links the market value of these shares of ownership to the biological yield of the assets (Arnason, 2008). Notably, ITQ methods have acquired worldwide popularity in recent years due to their efficacy in addressing common resource challenges in the fishing industry (Hoshino et al., 2020).

***Sustainability of Fisheries Sector***

In the fisheries sector, sustainability concept applies to scientific studies combining fisheries population trends and actual harvesting tactics (National Geographic, 2016). The goal of this approach is to prevent exploitation and contamination as a result of fisheries. Personal fishing rights, limiting damaging, illegal hunting, and protecting the ecosystem are among the approaches suggested (National Geographic, 2016). Crawford Global Technical Services (2016) described environmental hazard as the real or potential concern of pollutants and depletion of resources having a negative impact on living creatures and the ecosystem. Structural, chemical, or biological ecological risk concentrations can have a negative influence on soil, water, air, natural resources, or the overall environment, including on animals and plants (US Environmental Protection Agency, 2017).

Aquaculture in Malaysia is currently being positioned as a catalyst for economic progress, with the potential to emerge as a pivotal industry in the nation's future. Malaysia has consistently prioritised the inclusion of this industry in its national development initiatives, recognising its advantageous positioning in an area abundant in surface and groundwater resources, which are crucial factors for the successful implementation of aquaculture systems. According to estimations, the annual consumption of fish is projected to increase to 1.93 million tonnes by 2020, driven by a growing population and an increasing demand for fish as a valuable source of protein. The Aquaculture Industrial Zone (AIZ) Project, initiated by the Department of Fisheries (DOF), aims to establish 49 designated locations around Malaysia for the purpose of cultivating several species of fish in controlled environments. The Department of Fish and Wildlife has designated many critical regions for downstream activity, including fish farming cultivation, feeding mills, fish slaughterhouses, and other supportive sectors. Aquaculture is also one of the 16 National Key Economic Area's Entry Point Programmes (EPP) in the Agro-Food sector (NKEA). The administration wants to raise the participation of the agricultural production industry to GNI from 20.2 billion Malaysian Ringgit (RM) in 2010 to 49.1 billion Malaysian Ringgit (RM) in 2020, a net gain of RM28.9 billion (Yusoff, 2015).

Water contamination, air pollution, and ecosystem degradation are the three basic factors used to assess environmental hazard (Salleh & Halim, 2018). Despite the fact that these risk assessments came from diverse sensors, it is critical to include them in a single model before providing countermeasures. Furthermore, policymakers are aided by a unified framework that can handle with several components. The categorization of these three factors is based on numerous research' suggestions and adaptations. Water contamination is described in various of terms. It generally refers to one or more pollutants that have accumulated in groundwater and are causing difficulties for people, wildlife, and the environment. Seas, ponds, streams, and other inland waters may automatically wash up a large number of pollutants by ineffectually distributing it (Salleh & Halim, 2018). Water contamination caused by oil spills from ships (such as fishery and commerce fleets), discarded rubbish, and agricultural waste, on the other hand, is complex to handle and extremely difficult to spread normally. Washing vessels and disposing of oil are two practises in the fishing industry that pollute the water. The surface of the sea is coated and contaminated with oil released as a result of these operations. Furthermore, inadequate disposal practices at seaports exacerbate to fishermen's lack of understanding. Coastline populations, sea creatures, and vegetation are all affected by ocean pollution. This contamination was initiated into the marine ecosystem by humans, either explicitly or implicitly, leading to stress such as damage to ecosystems and biodiversity, threat to public health, impediment to aquatic commercial fishing, deterioration of sea water freshness, and decrease of facilities (GESAMP, 1991).

Natural and anthropogenic activity can both contribute to air pollution. Weather phenomena, on the other hand, pollute the environment less frequently than human behaviour. For instance, vessel emissions are a substantial cause of air pollution, and it is anticipated that, if no measures are implemented, emissions of carbon dioxide from different types of vessels (which now account for 2.2 percent of the overall man-made emissions in 2012) will increase by two to three times by 2050. (International Maritime Organization, 2009; 2014). However, there is a belief that trawlers emit less pollutants, thus this has to be investigated further. According to expert opinion, the usage of chlorofluorocarbons (CFCs) and the expansion of jetty areas by destroying mangrove and 'nipah' plants are the main air polluters caused by commercial fishing.

If the fishing industry is not well-managed, it has the potential to harm ecosystems. Unlimited fisheries activity, exploitation, and oil spills are only a few of the factors that cause environmental degradation. Whenever oil spills on the top of the water, it is highly damaging to wildlife like marine gulls. According to the Malaysia Fisheries Act of 1985, habitat problems are aimed whenever a large quantity of seafood are harvested, restricted or prohibited fishing equipment is used, illegal laborers are smuggled in, coral reef habitats are damaged, or wildlife is interfered with. As a consequence, it's important to note that fuel spills from trawlers, exploitation, and fisheries sewages can all cause environmental problems in the fisheries sector.

The focus is on damaging ecological effects because the (comprehensible) objectives of so much fisheries management primarily involve the restoration of species diversity and the preservation of fish populations as end points in themselves, instead of acknowledging and interacting food security in the realm of human progress (Foale 2001; Foale and Macintyre 2005). A plethora of picture books centred around Malaysian fishing have been lately published. In a study conducted by Mohsin and Ambak (1996), a total of 710 marine fish species were identified in the waters of Malaysia and the surrounding seas. Furthermore, Ambak et al. (2010) and Chong et al. (2010) reported the identification of 2,243 and 1,951 species of fish in the waters of Malaysia, respectively. Consequently, Malaysia boasts a fisheries industry that is globally recognised for its extensive size and remarkable diversity. Malaysia is recognised as one of the twelve mega-diversity hotspots worldwide and is also a constituent of the Coral Triangle, a region including six states that has the most extensive and affluent coral reefs globally. These coral reefs encompass a remarkable variety of over 1,000 coral species (Chong et al., 2010). Malaysia is geographically situated within the Indo-Pacific region, encompassing West Malaysia (Peninsular Malaysia), Sabah, and Sarawak. The Malaysian states of Sabah and Sarawak are located in the northern portion of Malaysia, namely on the island of Borneo. The southwestern region of the South China Sea serves as a geographical boundary, delineating the separation between two distinct land areas. The coral reefs of the South China Sea, which are the largest in any temperate ocean, have been impacted by environmental variables such as cyclones and bleaching events associated with El Nino. Furthermore, it is worth noting that the actions of humans are presently resulting in substantial degradation of reef habitats (Arceo et al., 2001). Several nations in the region have had rapid economic and social progress, as well as a significant increase in population, particularly in their coastal areas, over the past decade. Consequently, there has been an increase in human demands placed upon coral reefs. According to the findings of Burke et al. (2002), a significant proportion of Southeast Asia's coral reefs, specifically over 80 percent, are currently facing threats. The coral reef habitats and associated biodiversity in Malaysia have faced persistent threats due to a combination of natural calamities and extensive coastal development, which is also prevalent throughout Southeast Asia.

***Fish Security Target in Malaysia***

According to the Food and Agricultural Organisation (FAO), food security encompasses several essential components, which can be classified into four areas, including food availability, food access, food consumption, and food stability (FAO, 2006). In contrast, the concept of food security and nutrition has evolved from UNICEF's theoretical framework on malnutrition (Jonsson, 2010), which encompasses the elements of food security while also acknowledging the crucial role of addressing nutrient concerns such as treatment and nutrition education, public health, and sanitation issues (CFS, 2012). The concept of food and nutrition security (FNS) has gained recognition as a significant term that serves to unify the concepts as a shared goal of legislative and governmental actions, given their interconnected and mutually dependent nature (CFS, 2012). The Food and Agriculture Organisation (FAO) proposes a framework centred around food that incorporates elements such as food availability, nutritional diversity, and feeding practises in order to achieve food and nutrition security (FNS) (FAO, 2011). Within this particular framework, the value of land-based agricultural and food systems is widely recognised, but the importance of fish and fisheries in relation to food and nutrition security (FNS) is frequently disregarded (Thilsted et al., 2014; Béné et al., 2015). Although the consumption of fish in low- and middle-income nations (LMICs) remains insufficient, it is noteworthy that fish can serve as a significant and beneficial source of high-quality protein, minerals, vitamins, and essential micronutrients (Tacon & Metian, 2009).

Food security is linked to the abundance of fish populations accessible, according to a common theme in the marine conservation literature. Overharvesting and the deterioration of marine habitats are stated to cause "severe food security difficulties" (Pauly et al., 2005) or to "threaten food security and hunger-reduction efforts" (Mora et al., 2009). Preservation initiatives and other actions aimed at reducing exploitation are thus expected to enhance food security by increasing fish abundance. Food security is one of the goals of the Coral Triangle Project on Coral Reefs, Fisheries, and Food Security, a significant Asia-Pacific multinational accord. The creation of MPAs (Foale et al., 2013), which produce extra fisheries, has been the principal mechanism by which it has sought to accomplish this. But nevertheless, there is less focus on the particular manner in which fish make a contribution to various components of food security at the family or local level, and there is very limited focus on the social economic aspects that facilitate this association, such as modifying living standards and interrelations with group, gender, and social standards related to eating. A second element of the food security paradigm in fisheries management is the limited attention on the function of commerce in providing food security, and a matching overreliance and precedence of fish supply and consumption According to Cruz-Trinidad et al. (2014), selling fish just 'augment[s]' food supply, and "fisheries play a crucial role in sustaining food security at the community scale, primarily via fishes eaten in families." The harmful effects of commerce on biodiversity and fish populations are frequently addressed (e.g., Brewer et al., 2012; Cinner et al., 2013; Sadovy et al., 2013). As per Loring et al (2013) state "Fisheries are more typically perceived as a part of the world's food security challenge rather than as part of its prospective solutions".

For the past decade, global catch marine fisheries have been largely steady (FAO 2018). Nevertheless, between 2006 and 2011, worldwide catches of fish species (except vegetation) ranged somewhere around 7.77 and 8.04 107 t, with extra loses projected to be around 7.3 106 t. (Kelleher 2005). International harvest limitations have been claimed to have been achieved (e.g., Chassot et al., 2010; Worm and Branch 2012). The global fisheries activity, on the other hand, keeps rising. Fisheries capacity has rose by an average of 10-fold internationally and 25-fold in Asia since the 1950s, according to an international set of data on fisheries production (Watson et al., 2013), despite the fact that productivity in certain industrialised nations has decreased recent years. In addition to reducing targeted species abundance, overfishing has evident environmental implications for targeted species and aquatic habitats overall (Botsford et al., 1997; Murawski 2000).

Based on a recent analysis conducted by the Department of Fisheries Malaysia (DOF, Malaysia), it has been determined that the agricultural sector contributes around 12.5 percent to Malaysia's Gross Domestic Product (GDP), while the overall anticipated trade value is estimated to be USD 1.75 billion (RM 7.5 billion) (Department of Fisheries, Malaysia (DOF), 2020). The agricultural industry in Malaysia plays a significant role in the country's self-sufficiency capability, accounting for approximately 92 percent. Moreover, this sector also serves as a major source of employment, providing jobs for more than 18,000 individuals. One notable example is the aquaculture industry in Malaysia, which has achieved a production volume of 391,000 metric tonnes, corresponding to a market value of USD 724 million (RM 3.1 billion) according to the Department of Fisheries, Malaysia (DOF) in 2020.

***Government Policies for Fish Security in Malaysia***

Malaysia has widely employed international/regional mechanisms and conventions in order to develop a sustainable fisheries management system (Edeson et al., 2010; Ahmad, 2011). Over the last few decades, this current legislation has helped Malaysia make plans for sustainable fishing practises, build governmental procedures, and secure the resources required to achieve good fisheries policies. The Department of Fisheries and Oceans (DOFM) is the federal regulatory body responsible for developing fisheries legislation and strategies in alignment with international agreements, including the United Nations Convention on the Law of the Sea (UNCLOS). The 3rd UNCLOS, for instance, extended coastal governments land ownership to run its operations in oceans up to 200 nautical miles offshore in 1982. (Mohamed, 1991). According to Article 56 of the UNCLOS states that "The coastal state has sovereign rights for the purpose of exploring and exploiting, protecting and managing the natural resources of the seabed, subsoil, and adjoining adjacent waters, whether living or non-living."

Subsequently, Malaysia introduced the Fisheries Act of 1985, followed by the implementation of various international agreements and codes. These initiatives have played a significant role in refining the Fisheries Act of 1985 and promoting the development of the National Plan of Action for the Management of Fishing Capacity 1 2007–2010 (NPOA 1) and NPOA 2 (2015). The ultimate goal of these efforts is to achieve sustainable fisheries and establish an optimal fishing limit (Gopinath and Puvanesuri 2006; DOFM 2015).

In order to oversee the implementation of these principles and essential operational strategies, two prominent fisheries organisations were established, namely the Department of Fisheries Malaysia (DOFM) and the Fisheries Development Authority of Malaysia (FDAM). The Department of Fisheries Management (DOFM) assumes the responsibility of overseeing the progression of events, the executives, and guidelines pertaining to the fisheries sector. On the other hand, the Fisheries Development and Management (FDAM) organisation aims to enhance the livelihoods of fishermen via various initiatives. These initiatives include the provision of landing infrastructure, the promotion of ecotourism, the marketing of fisheries products, as well as facilitating the issuance of import and export licences. The Department of Fisheries and Oceans (DOFM) is the primary governmental entity responsible for the regulation and conservation of marine fisheries. In contrast, the Fisheries and Anglers' Financial Division (FDAM) primarily focuses on the financial aspects related to anglers (Abdullah, 1995). Over the past four decades, many significant information controls measures have been implemented in order to achieve optimal fishing effort in inshore fisheries. These measures include the implementation of drafting systems, limits on inshore fishing licences, and regulations pertaining to fishing gear.

Hence, the measures pertaining to the fishing industry can be classified as the policies, regulations, and institutions that coordinate, oversee, or direct the food system. These entities encompass governmental bodies as well as non-state entities such as markets, traditions, corporations, and civil society (van Bers et al., 2019). This analysis focuses on science-based innovation policy actors and examines the rationale behind their efforts to promote a system that ensures food security.

Formal institutions are purposely developed in aquaculture to safeguard fish stocks and reconcile the fleet's capture capability with the natural resource. Fish is a common good in public, uncontrolled fishery that everybody has the right to utilize excessively (Gordon, 1954; Hardin, 2019). As a result, increasing a vessel owner's fishing effort is a sensible approach as long as the harvest revenue surpasses the expenses of trawling (Pascoe & Revill, 2004). As a result, if every ship's captain follows their own logic, thus the scarce natural renewable item will be overexploited. As a result, individual and communal rationality are in war (Gordon, 1954; Hardin, 2019). The burden of overfishing is borne by all other fisherman, which contributes to the tragedy of the commons. Another cause is a lack of concerted group action to conserve the fish species. As a result, regulatory mechanisms are essential to ensure the ecological and economic sustainability of fishing (Ingram and Silverman, 2002).

Economic players can create purchasing authority by partnering and coordinating (Porter, 2008). The Norwegian Fishers' Sales Team of Herring (Norges Sildesalgslag in Norwegian) is a national sales organisation for migratory types of fish such as blue whiting, mackerel and herring. Norwegian fishermen manage and own the market. It is 's biggest auctioneer for marine fisheries first-hand purchases (Sogn-Grundvg et al., 2019). The organisation has the authority to determine floor price for the fish being sold, as well as payment and delivery arrangements. It also manages advertising on a worldwide level. Norges Sildesalgslag trades about two million tonnes of pelagic fish every year. This amounts to 2–2.5 percent of all wild fish marketed worldwide.

Government regulation, such as needing a fishing licence, might make it difficult to enter a fishery. In industries with high barriers to entry, established companies get a competitive edge over outside companies. A new entry will add significant capture capability and a demand for a piece of the TAC, with the benefit represented in economic success for most of those safeguarded by hurdles (Porter, 2008). If the fishery already has oversupply, it will be exacerbated (Bertheussen et al., 2020). A new competitor will also put a burden on allocation values and the cash flow allowed to succeed. As a result, the possibility of entrance limits a fishery's potential value.

The method used to collect and disperse a fishery's rental (impact fee and commodity fee) to community will have an impact on the sector's desirability and, as a result, the participants' chances of making a fortune (Bertheussen and Vassdal, 2019). Governments have made little efforts to regulate the rental from fishermen on a global scale (Hoshino et al., 2020). Iceland imposed a fishery charge in 2004 to pay the costs of administration and compliance (Gunnlaugsson et al., 2018). It was increased rapidly, nevertheless, to guarantee that a portion of the fee was handed to the community in order to foster public support for the ITQ method. New Zealand likewise tried but failed to implement a resource rental tariff (Hoshino et al., 2020) The rental tax from fishing industry goes mostly to the permit holders if there is no redistribution (Flaaten et al., 2017).

On the other hand, Porter (2008, 1997) argues that a company's long-term economic profit is determined by its value chain. He claims that the power of five forces model influences how the real benefit generated by the sector is distributed among key parties, such as how much is maintained by companies in the sector versus how much is agreed to pay aside by suppliers and customers, restricted by replacements, or constricted by fresh entrants. In the context of natural renewable resource-based sectors, governments may have a far greater need to regulate the nature of competition at work, as unrestrained consumption could lead to supply degradation (Gordon, 1954; Hardin, 2019). This has made a requirement for governments to step in and give logical guidance on what amount ought to be reaped, and what measures ought to be set up to guarantee that the TAC set won't be overfished (Arnason, 2008).The limit change can either be coordinated straight by the public authority through purchase outs and comparable plans, or by implication by the business through the presentation of standard frameworks, and the setting up of a TAC will without anyone else not end the competition to fish, and much of the time the limit of the fishing armada should be diminished (Birkenbach et al., 2017). There is accordingly a principal contrast between the requirement for governmental regulators in fisheries than in numerous different parts of other economic actions.

Due to the nation's large marine reserves in both coastal and interior waters, capture fisheries continue to control Africa's local fish supply. Morocco, Nigeria, and South Africa are the continent's top 3 aquaculture providers (FAO, 2018). Small-scale fishes serve an important role in African economies, offering employment for huge numbers of people, particularly in rural regions, and have been greatly enhanced by the importance of fisheries in food security and revenue growth (Béné et al., 2009). Africa presently generates approximately 10.2% of world fishing activities (FAO, 2018). Most African marine stocks, like those of the rest of the globe, are depleted. According to recent research, about half of Africa's fish populations are overfished or entirely exhausted (Chan et al., 2019). Consequently, notwithstanding catch fishing' supremacy in total fish output on the region, aquaculture's prospects as a new area for development remains significant. Fish farming accounts for almost one-sixth of Africa's total food fish production in 2016. (FAO, 2018). The majority of African countries have a fish shortage of supply, which provides substantial opportunities for aquaculture growth.

According to the most recent demographic projections, Africa will account for more than half of population increase between now and 2050. (UN, 2017). Fish shipments in Africa have expanded significantly in the recent ten years to fulfil growing demands and address native fish supply shortages (FAO, 2018). Whereas emerging economies overall remain to be economic powerhouses of fish, Africa is a heavily dependent on imports of fish in terms of volume. Surprisingly, it has been a leading contributor of fish in terms of value, implying that importation have a dramatically lower value (Béné et al., 2010). Low-value tiny migratory species of fish, especially mackerel, predominate African fish importation, which are considerably large in nutritional content (FAO, 2018, Isaacs, 2016). As a result, most African nations, as low-income countries, are exporting relatively high fisheries in order to accomplish the wider objective of reducing hunger, while maintaining and importing poor nutritional fisheries to ensure food security (Watson et al., 2017).

Multiple marine experts in Malaysia agree that the primary cause of overharvesting in Southeast Asia's fisheries is an over availability of resources (Pomeroy, 2012; Islam et al., 2011). Several recent studies have provided evidence of significant declines in fisheries. These include observations of impoverished landing sites for high-value fish, accompanied by a high proportion of hogfish and a consistent increase in squid landings (Sany et al., 2019). Additionally, there has been a notable decrease in fishing efficiency, with a decline from 15.7 tonnes per fisher in 2001 to 11.7 tonnes per fisher in 2015 (Hiew et al., 2012). Furthermore, it is possible that certain fishing vessels have encountered difficulties in meeting the minimum annual landing requirement of 250 tonnes, which is necessary to maintain their fishing authorization (Nuruddin & Isa, 2013). The period from 2004 to 2012 witnessed a notable increase in the captures of high-valued fisheries, particularly those of pelagic species. However, it is important to note that this surge can be mostly attributed to the expansion of commercial fishing activities rather than a genuine growth in the pelagic population (Miat Piah et al., 2018). In a recent ethnographic study conducted by Wong (2020), it was shown that local fishermen in Sekinchan who had less education displayed a cautiously optimistic outlook towards trawl harvesting. Despite the loss in fisheries, these individuals were able to sustain a modest livelihood by targeting lower-value species.

Malaysia created the NPOA 1 (2004) and NPOA 2 (2015) under the supervision of the FAO International Plan of Action for the Management of Fishing Capacity (IPOA-capacity) to ameliorate the surplus congestion issue by lowering unnecessary fishing activity. DOFM was established to promote ship operators to move to farther offshore and less fished waters, renounce the licences of unsuccessful fishing vessels, and adopt methods such as maintaining a nearshore licence ban and providing an escape route for fishing fleets under 40 tonnes (Ahmad, 2011). The Malaysian Maritime Enforcement Agency (MMEA) was formed later to combat illicit, unregistered, and uncontrolled (IUU) trawling. Nuruddin and Isa (2013) performed study and discovered that the boat dismantling strategy failed given the lack of funding. Assessments by Williams and Staples (2010) and Sany et al. (2019) found that capability restriction efforts were ineffective because aquaculture officials neglected the fast expansion in licensed/unlicensed conventional equipment and refused to deliver specified vessel requirements to limit harvesting capacity. Furthermore, DOFM recognized a lack of financing and manpower to oversee fisheries rules throughout expanded territories (especially IUU harvesting), but it raised incentives under pressure from the government since it lacked data on multispecies fisheries. Furthermore, undocumented harvests of unlicensed/licensed professional and amateur fishermen, as well as their disregards at ocean, are frequently ignored by government official yearly harvest records (Jagerroos, 2016).

On top of that, Alam et al. (2011a) which investigates the efficacy of governmental and external agency assistance in facilitating the adaptation of Malaysian paddy farmers to the swiftly evolving climatic circumstances. According to the study the majority of farmers hold the belief that purchasing more fertiliser is not essential for their current level of adaptability. However, a notable proportion of farmers express dissatisfaction with the current level of government assistance in addressing the challenges posed by climate change. This study highlights the importance of external support networks in promoting the long-term viability of agriculture and the livelihoods of farmers. A comprehensive approach is required, surpassing the reliance on incentives and subsidies, and placing emphasis on the significance of training and motivational measures in order to strengthen farmers' capacity to effectively respond to the difficulties posed by climate change. In summary, the research highlights the significance of comprehensive support systems in facilitating farmers' ability to effectively manage the consequences of climate change. Similar studies are also in agreement with these conclusions on fish security due to the threats of climate change (Alam et al., 2010; Alam et al., 2011a, b; Alam et al., 2012a, b,c; Alam et al., 2016 a,b,c,d; Alam et al., 2017; Alam et al., 2018a,b).

## Fish Security Status in Malaysia

### *Fish Availability and Accessibility*

While these descriptions of fish availability, food security, and commerce may not be wrong, however the intricacy of the interaction among fisheries and food security receives little attention. Food security is defined as the accessibility, availability and utilisation of fish as a food source in this context. From the viewpoint of food fish ecosystems, controlling food security necessitates taking into account the various ways in which supply, provision, and usage engage (Ericksen 2008; Ingram 2011). The difficulty of providing for the whole spectrum of food chain operations contrasts sharply with the productivism perspective that characterizes most of the knowledge that underpins food policy in emerging nations (Ickowitz et al., 2019). Because of this emphasis on production, food security governance has relied primarily on the technological innovations to boost production, with the premise that availability of food would alter provision and consuming behaviours (Ickowitz et al., 2019; Gómez et al., 2013).

The marine science literature frequently vastly overstates 'availability,' assuming that larger fish populations resulting in greater capture fisheries or preservation will inevitably lead to increased food security. However, increasing fish abundance does not always imply increased food security. Darling (2014) revealed that two well-enforced MPAs had no impact on domestic food security in a recent survey in Kenyan coastal villages. MPAs can have the absolute reverse impact for some clusters: while they may boost the total supply of food by limiting community members' accessibility to fisheries, they can also have extremely severe consequences in terms of short-term food security (e.g., Kamat 2014). Given the many various views of food security and its sophisticated, multi-dimensional structure, any claimed links among better fish supply and food security in coastal contexts must be more precise and detailed. The 'food availability' paradigm implicit in most of the marine conservation literature, as Burchi and De Muro point out (Burchi & De Muro, 2015), is component of an earlier and wider discussion, tied to Thomas Malthus, that is excessively restricted in its interpretation of food security.

### *Fish Utilization*

The complete spectrum of processes related to the choosing, buying, cooking, and eating of fish is defined as fish utilisation or consumption. Consumption is impacted by a variety of activities that define which fish species are bought, in what shapes (e.g., fresh, processed, or prepared), from which sources (e.g., moist marketplaces, groceries, or diners), and with what regard to excellence (food standards, flavor, or tradition) (Spaargaren et al., 2013). Consuming is influenced by transformation plans of urbanisation, industrialization, and/or food (in)security, rather than by human decision solely, according to a systems view (HLPE 2017).

Eastern Asian communities ate fish every day with boiled rice, as part of rice meals, or as a dipping sauce (Burger et al., 2003). Malaysians, especially, ate fish at least once a day, in quantities of one and a half medium fish (Norimah et al., 2008). In fact, Malaysians consumed the second most fish per capita in Asia, after Japan, and ranked fifth in the world (Moya et al., 2008). Demand for fish is an important part of a balanced and nutritious food (Csavina et al., 2014). Fish eating may have healing properties due to the inclusion of protein, unsaturated healthy fats, minerals, and vitamins (Sidhu, 2003). Unsaturated fatty acids (PUFAs), particularly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), may provide extra health advantages from fish or fish oil consumption (Domingo et al., 2007; Sidhu, 2003) Fish include omega-3 fatty acids, which may lower levels of cholesterol and lower the risk of heart illness, dementia, and premature birth (Rincón-Cervera et al., 2020). It also functions as a mood stabiliser, particularly for women (Silvers & Scott, 2002; Timonen, 2004).

***Fish Stability***

Structural changes of aquatic habitats have ramifications for the captured species. Harvesting can change interactions among species by reducing competition for weakly caught subgroups or increasing per capita preying on intensively targeted species, leading in even more demographic decline in intensively exploited groups (Daan et al., 2005; Zhou, 2008). Because the nutritional similarities among cod–dogfish and flounders–skates are normally high, high targeted fishing effort on cod and flounders may have enhanced the prevalence of dogfish and skates on Georges Bank (Murawski & Idoine, 1992). As a consequence of rivals reducing their range, the capacity factor of intensively exploited fisheries may be diminished. Fishing reduces a species' numbers and dispersion area, allowing less harmed species to fill the territory previously inhabited by the seriously affected groups (Bundy, 2001; Planque et al., 2010). Furthermore, alterations in life-history characteristics and changed interspecific relationships produced by historical overfishing have been blamed for the failure of some overfished fisheries to rehabilitate (Hutchings & Reynolds, 2004; Van Wijk et al., 2013).

Coral reefs in Southeast Asia are facing significant threats such as overexploitation, marine expansion, and climate change (Burke & Selig, 2002). According to Wilkinson (2000), if the current trend of deterioration persists, it is projected that over 50% of the global coral reefs would be lost within the next three decades. The decline of coral reefs in Southeast Asia, a region that harbours approximately 32 percent of the global coral reef population, exerts a significant impact on the coastal ecosystems of this area, renowned for its high ecological value and economic prosperity (Allen & Werner, 2002). The reefs located in the South China Sea of Malaysia have been identified as a significant contributor to the economic prosperity of coastal communities (UNEP, 2004). Coral fisheries constitute a significant proportion of commercial fisheries, and seafood serves as the principal source of protein for Malaysians (Kawarazuka, 2010). Coral reef aquaculture play a significant role in providing a vital protein source for those residing in tropical fishing towns. Coral reefs are essential environmentally because they provide larval and adolescents for many economically significant reef species of fish and other creatures. Many migratory and demersal species of fish located in the open sea use corals as mating and rearing sites. As a result, safeguarding and preserving coastal and marine ecosystems is critical for the sustainability of future utilisation fish stocks.

The South China Sea contains the largest corals of any tropical ocean. Although environmental factors such as cyclones and El Nino-related bleaching catastrophes (exacerbated by globalisation caused by human activities) have an impact on coastal ecosystems, human activities are currently causing significant reef habitat degradation (Arceo et al., 2001). During the past century, many nations in the region have experienced rapid industrial growth and population growth, particularly in coastal regions. Consequently, human pressure on coral reefs has increased. The construction of coastal infrastructure to facilitate economic development has contaminated the marine environment, resulting in the depletion of reefs near major population centres. Resource extraction has led to severe coastal deterioration, erosion, and drainage deforestation, all of which have contributed to extensive coral reef destruction. All of these factors have an effect on the overall health of reef systems. The patterns of coral reef degradation are unknown due to a paucity of information and data regarding the condition of coral reefs over the past few decades. Burke et al. (2002) calculated the threats to Southeast Asian coral reefs. Over 80% of Southeast Asia's coral reefs are threatened by overexploitation, blow harvesting, noxious fisheries, and trawling in East Malaysia, according to Burke et al. (2002).

Therefore, rigorous fisheries regulation, the restriction of blasting and poisoned fisheries, and advancements in coral reef fishing equipment are necessary. In spite of the fact that dynamite fishing is illegal in Malaysia and heavily regulated in West Malaysia, it is still practised in some parts of East Malaysia, particularly Sabah, because it is evidently simpler and allows fishermen to earn more money. Off the eastern coast of West Malaysia, the thirty-eight coral reef conservation areas, also known as national marine parks, are helpful for tropical preservation. Recent studies indicate a significant turnaround, with hard coral reefs reaching their maximum level around the Perhentian islands even though regular surveys have been conducted since 2007 (Reef Check Malaysia, 2012), indicating an increase in the reproduction and breeding sites accessible to numerous coral reef marine species as well as other pelagic and demersal species of fish found in the region. More than fifty percent of live coral reefs have been documented surrounding Tioman Island for the past five years (Reef Check Malaysia, 2012) despite the fact that coral reef conditions have barely improved. In contrast, large portions of the coral reefs off the coast of East Malaysia continue to be threatened, with only four islands designated as federal marine reserves. Both environmental (e.g., cyclones, disease) and human-caused (e.g., bomb harvesting, toxic fishery, exploitation) threats are severe in East Malaysia, and preserving reefs in specific regions may help them withstand them. Urgently required are the expansion of coral reefs within designated coastal conservation areas and the establishment of the necessary funds to ensure the effective implementation and resilience of such fishery groups in the region.

## 4. Conclusion

In conclusion, this study reviews status fish in the context of Malaysia, casting light on the complex interactions between fish availability, utilisation, and ecological stability in the context of food security amid climate change and population growth challenges. By calling into question the traditional emphasis on production-driven approaches, the study demonstrates the need for a paradigm shift in food security governance and urges a comprehensive understanding of consumption behaviours, supply chains, and ecosystem health. The importance of fish in Malaysian diets, coupled with its nutritional benefits, highlights its crucial role as a source of staple protein, which makes the threats posed by overexploitation, habitat degradation, population growth and climate change all the more alarming.

This study challenges the prevalent notion of 'availability' as a sufficient measure of food security, which has theoretical implications. In policy formulation, the research recommends a holistic approach that takes into account consumption patterns, supply chains, and ecological complexities. The study emphasises the need for balanced policies that prioritise habitat preservation, sustainable fishing practises, and ecosystem conservation alongside production objectives. This integrated viewpoint provides a basis for assuring the long-term viability of fish resources while protecting coastal ecosystems and the livelihoods they support.

Based on various information search and readings, there are some suggestions in terms of measures to increase the fishing productivity and food security.

- To introduce modern fishing activities that do not interact with external weather elements such as aquaculture fishing methods.
- To provide training where fishermen will be trained and exposed to manage deep sea fishing and aquaculture activities as well as the management and operation of modern fishing equipment. Moreover, creating cooperatives involving various levels will make it easier for fishermen to obtain credit facilities to be used as capital in undertaking fishing activities and related activities. It will also allow fishermen to obtain various fishery inputs at lower prices, reducing the grip of middlemen in the marketing process of their catch.
- To provide funding and capital assistance to potential fishermen who are able to carry out fishing activities well.

The limitations of the study include its Malaysia-specific focus, which may limit its generalizability, and its reliance on extant literature, which may not account for the most recent developments. Exploring the socioeconomic implications of shifting consumption patterns, evaluating the efficacy of policies, and investigating the roles of local communities in sustainable fisheries management are enumerated as future research directions. In conclusion, the exhaustive analysis of this study provides a nuanced understanding of fish security and urges a holistic approach that recognises the intricate interplay between various dimensions for a resilient and sustainable food security framework in Malaysia and beyond.

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