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CHAPTER 14

State of marine fish and fisheries in Malaysia

CHITRA DEVI GOPALAKRISHNAN[1]*, RAYMIE NURHASAN[1], FADZLIEE ASMAT[1], SERENA ADAM[1], ALIAS MAN[2] and NURFATIN WAHIDA PUSPA[1]

Abstract: Malaysia's capture fisheries have long been central to national food security, livelihoods, and cultural heritage, supplying 60% of the country's animal protein and employing over 105,000 fishermen. However, wild fish catches have declined sharply, falling 17% from 1.57 million tonnes in 2016 to 1.39 million tonnes in 2024. Scientific assessments reveal severe depletion: demersal fish biomass has dropped by up to 90% since the 1960s, and catch per unit effort has plunged by 96% in some waters. Overfishing, destructive gears like trawling, habitat loss, and climate change are key drivers, compounded by illegal, unreported, and unregulated (IUU) fishing costing billions annually. This decline threatens food security as Malaysia's fish self-sufficiency ratio fell from 93% in 2019 to 90% in 2022, increasing reliance on imports and raising seafood prices. Coastal communities face deepening poverty, with over 28% of East Coast fishers living in extreme poverty. Ecologically, collapsing stocks disrupt marine food webs and biodiversity. Future strategies must integrate science-based management, spatial protection, and co-management with communities. Strengthening fisheries governance, expanding MPAs, improving traceability, and leveraging blue finance are critical to reversing trends. Without urgent action, Malaysia risks losing both marine biodiversity and the socio-economic lifeline that fisheries provide.

INTRODUCTION

Overview of Malaysia's marine fisheries

Malaysia's capture fisheries are important to the nation's food security, economy, and cultural heritage. Fish and seafood are staples of the Malaysian diet, providing roughly 60% of the country's animal protein (Ahmad *et al.* 2003b). In fact, Malaysia ranks among the world's top seafood consumers, with an average of 49 kg of fish consumed per person in 2020 (FAO 2026). Besides that, the fishing industry supports livelihoods in coastal communities and contributes to the national income by employing about 105,000 fishermen and accounting for RM11.8 billion (0.8%) of Malaysia's Gross Domestic Product (GDP) in 2024 (Department of Fisheries Malaysia 2024a). Capture fisheries also touch on cultural significance, sustaining traditional ways of life in fishing villages and providing many iconic ingredients in Malaysian cuisine.

In recent years, however, Malaysia's wild fish catch has shown clear signs of decline and stagnation. A century-long reconstruction of Malaysian marine landing data (1907 – 2021) confirms that total species landings followed a near-unbroken upward trajectory for ninety years before peaking in 2016 and declining thereafter, with recent trends suggesting commercial stocks may now be locally depleted in multiple fishing grounds (Ng *et al.* 2025). In 2022, total national fishery production reached 1.89 million metric tonnes (mt), with aquaculture contributing approximately 30% of this figure; marine capture fisheries have stagnated due to overfishing and environmental pressures even as aquaculture has

[1] WWF-Malaysia, 1, Jln PJS 5/28 A, Pusat Dagangan Petaling Jaya Selatan, 46150 Petaling Jaya, Selangor, Malaysia.
[2] Department of Fisheries Malaysia (retired), Aras 1-6, Blok Menara 4G2, Presint 4, Pusat Pentadbiran Kerajaan Persekutuan, 62628 Putrajaya, Malaysia.
***Corresponding author: cdevi@wwf.org.my**

expanded (Obi e*t al.* 2025). By 2023, production had fallen further to 1.79 million mt, a 5.5% decline from 2022 with marine capture output contracting from 1.46 million mt in 2019 to 1.27 million mt in 2023 (SEAFDEC 2025).

Overall, it is estimated Malaysia has lost over 90% of its demersal fish stocks in the past half-century due to over-exploitation (Ahmad *et al*. 2003a, 2003c; Ismail *et al*. 2022), with studies revealing that many fish stocks are depleted or under heavy stress. National trawl surveys conducted between 2013 and 2016 found that demersal fish biomass had declined by 88% compared to virgin stock levels recorded in the 1960s (Fisheries Research Institute 2017).

Disaggregated data reveal an even more alarming regional picture: coastal demersal stocks along the West Coast of Peninsular Malaysia now stand at only 4% of their 1960s biomass, while East Coast Peninsular Malaysia coastal stocks are at 3%, substantially worse than the widely cited 88% decline figure and underscoring the near-total collapse of inshore demersal resources in these regions (Fisheries Research Institute 2017; 2018). Prawn stocks are equally alarming with exploitation rates in most peninsular states range from 0.8 to 0.9, indicating severe overfishing across virtually the entire coastline, with the lowest absolute biomass recorded in Kelantan and Terengganu (Fisheries Research Institute 2017; 2018). Many common high-value species such as large groupers, snappers, and croakers that were abundant in the 1960s until 1970s are now rarely seen in the local markets. Reef fish assessments at specific sites corroborate the broader trend where surveys at Kapikan Reef, Sabah found that over 70% of fish were under 5 cm in length with no large-bodied predators present, indicating severe localised stock collapse (Wood and Dipper 2008). Even within formally gazetted marine parks such as Pulau Payar Marine Park and Tun Sakaran Marine Park, fish stocks remain low, with key commercial families including Serranidae, Scaridae, and Lutjanidae recording minimal biomass (Man 2008; Alias 2000; Bavoh and Manjaji-Matsumoto 2022; Bavoh *et al.* 2023).

Large pelagic species are increasingly exhibiting signs of overexploitation alongside the better-documented demersal declines. On the East Coast of Peninsular Malaysia, longtail tuna has been overfished for at least five consecutive years with no recovery measures implemented, with an exploitation rate of 0.67 well above sustainable levels; frigate tuna is classified as at risk (E = 0.54) while Kawakawa remains healthy (E = 0.43) (FRI 2018; Long 2018; WWF-Malaysia 2026). For oceanic tuna species of transboundary relevance, Bigeye tuna is assessed as overfished in the Indian Ocean and Narrow-barred Spanish mackerel is overfished in the Western Pacific as of the 2024 assessments (Fisheries Research Institute 2024; Indian Ocean Tuna Commission 2024, Saleh et al. 2024). Small pelagic stocks show greater regional variation, with Sarawak holding the largest biomass at 521,169 mt and East Coast Sabah the lowest at 154,490 mt, though exploitation rates remain comparatively low in Borneo waters (Fisheries Research Institute 2017; 2018).

Malaysia is ranked as the world's eighth largest elasmobranch fishing nation, yet documented shark and ray landings have fallen dramatically with shark biomass declined approximately 15-fold from 6,487 mt to 438 mt and ray biomass approximately 9-fold, from 11,993 mt to 1,372 mt between 2018 and 2021 alone, suggesting severe population depletion (Department of Fisheries Malaysia data as cited in Loh *et al*. 2023). Equally important, collapsing fish stocks signal marine ecosystem distress. Overfishing does not only remove target species but it also disrupts food webs and degrades biodiversity, as evidenced by the rise in catches of low-value trash fish and juveniles when larger fishes are depleted (FAO 2005). Such declining catch trends and deteriorating stock health have raised serious sustainability concerns.

DRIVERS OF CHANGE AND ENVIRONMENTAL STRESSORS

Malaysia's capture fisheries are declining due to a mix of unsustainable practices and environmental pressures with decades of open-access fishing created excess capacity and severe overfishing. As trawling is the highest contributor to total fish landing in Malaysia, we can deduce that the decline of fish biomass is mainly driven by trawl fisheries in Malaysia. The negative impact of bottom trawl towards fish stock and habitat is well established.

In just a few decades, Malaysia's marine fisheries went from small-scale, traditional methods to an industrialised business. For a long time, coastal people have used handlines, traps, and basic nets to fish in the adjacent areas, only catching what they needed and creating a complex cultural identity at the sea. Between the 1960s to 1970s, modernisation of fishing quickly changed this industry in Malaysia, including the introduction of trawl nets and purse seiners that caused a boom in fish landings and made it possible for boats to fish farther out to sea and catching fish more effectively (Ng *et al*. 2025). Production went up from about 0.8 million tonnes in the middle of the 1980s to more than 1.2 million tonnes by the end of the 1990s (Ahmad *et al*. 2003).

However, it seems that modernity slowly became the "road" to overfishing. In the 1960s and 1970s, heavy trawling for prawns and fish in the shallow areas of the West Coast of Peninsular Malaysia quickly depleted inshore stocks (Kirkley *et al.* 2003). By the end of the 1970s, there were too many boats and fights between traditional fishermen and commercial trawlers. Small-scale fishermen, who could only fish in coastal seas because their boats were too small, saw their catches drop as trawlers picked up fish and prawns in high landings, often moving into areas close to the shore (Kirkley *et al.* 2003). In response, the Malaysian government made big changes in fisheries management in the 1980s in which the trawlers were not allowed to fish in nearshore seas except for artisanal fishing, and a zonal licensing system was put in place to divide fishing fields by vessel size and gear types. This approach was meant to stop overfishing near shore and maintain the livelihoods of local fishermen, while continuing increasing offshore fisheries for profit.

Despite management efforts, the results from scientific assessments by the 1990s were already alarming. The assessments concluded that major fishing areas in Peninsular Malaysia were overexploited, especially the demersal resources (Fisheries Research Institute 2017). Biomass showed drastic declines with only 5 to 10% of the original fish biomass remaining. The exploitation rates of most dominant species far exceeded sustainable levels, with fishing efforts estimated at 1.3 to 2 times the optimal level for maximum sustainable yield. These historical trends set the stage for the 21st century challenge; catches plateaued and now descending, as decades of overfishing have left fisheries' resources in a diminished state.

Illegal, unreported, and unregulated (IUU) fishing either by foreign or some local operators undermines fisheries management, disrupts statistics, and drains resources, costing an estimated RM3 to 4 billion annually. In 2019, Department of Fisheries Malaysia (DOFM) estimated that IUU fishing alone accounted for nearly 30% of total marine fish landings, indicating enforcement gaps of considerable magnitude (DOFM 2019). Destructive and non-selective gears such as trawling remove juveniles and cause bycatch, alongside illegal methods like blast or cyanide fishing, damaging spawning and nursery grounds.

Marine habitat loss from mangrove clearing, coastal development, and reef degradation further suppresses recruitment. Research highlights significant mangrove loss in Malaysia, such as the loss of 2,907.29 hectares (about 1.12% annually) between 2000 and 2019 in southern Peninsular Malaysia (Kanniah *et al.* 2021), which has crucial implications for

species dependent on these habitats, including prawns. The ecological role of mangroves as nursery grounds for prawns is well established, suggesting that such habitat loss has a substantial negative impact on prawn recruitment and population sustainability. The decline in mangrove areas correlates with the reduction in juvenile prawn habitats, affecting the overall prawn fishery productivity in the region.

The development of coastal areas like reclamation, deforestation, housing, and building development has caused siltation and water pollution in the area. The problem of siltation is particularly disturbing since it has a direct impact on the performance and growth of the fisheries industry in this country. Small-scale fishermen are the most vulnerable towards this problem since most of the fish and benthic species have seen a decline in number due to siltation. Their catch is decreasing and their source of livelihood is threatened. Based on the monitoring by the Department of Irrigation and Drainage Malaysia on the west coast, it was found that the rate of siltation in muddy river mouth can exceed one meter per year. Based on personal communication with a farmer in Melaka, the siltation is a very serious problem on the west coast of Malaysia, and many fishermen have difficulty covering their living costs due to low catch.

Climate change acts as a critical threat multiplier, compounding and accelerating damage caused by overfishing, and habitat loss. Rising sea temperatures, ocean acidification, and deoxygenation—the so-called deadly trio—collectively amplify coral bleaching and mortality, biodiversity loss, species range shifts, and disruption to reproduction cycles (Obi *et al.* 2025; WWF-Malaysia 2026). For fisheries, tropical fish stocks are shifting poleward as temperatures rise, reducing catch potential in traditional fishing grounds, while extreme weather, flooding, and salinity changes are increasing mortality and disease in aquaculture operations (WWF-Malaysia 2026).

The 2024 mass bleaching event is now recognised as the fourth global bleaching event and the most spatially extensive in recorded history, with over 80% of the world's reefs experiencing severe heat stress between 2023 and early 2025 (NOAA Coral Reef Watch 2026)—the reefs in Malaysia were severely affected. Over 90% of corals in Malaysian waters bleached at the peak of the bleaching season in April to June 2024 (Reef Check Malaysia 2026). National reef monitoring covering 297 sites showed average live coral cover falling to just under 40% in 2025, down from approximately 45% a year earlier and 50% in 2022 which is a 20% loss in three years, equivalent to the loss of some four million hectares of forest cover (Reef Check Malaysia 2026). In Northeastern Peninsular Malaysia, species-specific bleaching trajectories documented at Pulau Lang Tengah showed that this event was consistent with the most severe thermal stress events on record (Szereday *et al.* 2025). Since coral reefs function as essential nursery and feeding grounds for commercially important fish species, this trajectory of reef degradation directly suppresses future fish recruitment and biomass recovery.

Small-scale fishers in climate-exposed states such as Terengganu face compounding climate vulnerabilities: maximum monthly precipitation in the state is projected to increase by 51%, with a 10% increase in annual rainfall expected, and flooding events such as the 2021 floods caused substantial documented losses to fishing infrastructure and operations (Yamin *et al.* 2025). Besides that, climate change also causes shifting in species distributions, altering reproduction, and disrupting seasons through warmer seas and more unpredictable monsoons. The most significant impact on fisheries is a change in sea current circulation caused by disturbed temperature of seawater.

SOCIOECONOMIC DIMENSIONS OF FISHERIES

The socioeconomic consequences of fisheries decline fall most heavily on small-scale coastal fishing communities, which account for approximately 35% of total national marine landings while comprising the majority of the fishing workforce (DOF 2024a; Mohamad *et al.* 2024). The economic impacts include fluctuating income due to low fish catches, high dependency on fishing, limited access to financial services, and difficulty investing in better equipment or alternative livelihoods. In some rural coastal fishing communities, fishing accounts for over 70% of total household income, leaving families without any meaningful economic buffer against declining catches (Yeo *et al.* 2007; Solaymani and Kari 2014). Approximately 65% of the total fishing population in Malaysia are small-scale fishers, and 70% of Malaysia's overall population of 34.2 million live in coastal zones where marine resource dependency is structurally embedded in livelihoods (WWF-Malaysia 2026).

Poverty is disproportionately concentrated in fishing states: Sabah maintains a poverty rate of 17.7%, with eight of the nine poorest districts in Malaysia located within the state and five within the East Coast Sabah seascape; Kelantan follows at 11.5%, and Sarawak also records elevated coastal poverty rates (WWF-Malaysia 2026). In states like Terengganu and Kelantan, overfishing contributes to economic inequality and poverty among fishermen, where nearly 28% of fishermen in that area live in extreme poverty, and over 82% are considered poor overall, reflecting systemic economic exclusion linked to dwindling fish resources (Rhoumah 2017; WWF-Malaysia 2026).

A quantitative study of small-scale fishers in Penang found that coastal reclamation—a major driver of habitat loss identified independently from overfishing—severely degrades natural capital for artisanal fishers, reducing fish stocks and biodiversity, restricting access to fishing grounds, and raising operational costs including increased travel distances and fuel expenditure. Human and social capital provided bottom-up contributions to adaptive resilience, but financial capital was identified as critically limiting (Bamasood *et al*. 2025). This pattern confirms that the economic impacts of both overfishing and coastal development are synergistic, amplifying each other's effects on household income and food security.

The fisheries sector was valued at approximately RM 16.5 billion in 2023, supporting employment predominantly in coastal and rural areas (WWF-Malaysia 2026). Economically, coastal fisheries have been a safety net for rural communities, and with the stock decline, thousands of jobs and traditional livelihoods are threatened. Sixty percent of Malaysia's longtail tuna landings originate from the East Coast of Peninsular Malaysia, a substantial proportion of which is exported to Thailand, creating an economic dependency and transboundary management imperative that existing domestic governance arrangements are structurally ill-equipped to address (WWF-Malaysia 2026).

This decline of wild fisheries matters not just to fishermen but to the wider public. Total seafood production reached 1.89 million mt in 2022, but domestic demand increasingly outstrips what Malaysian waters can supply sustainably (Obi *et al.* 2025). With Malaysians heavily reliant on fish for protein, any drop in domestic catch threatens national food security. Malaysia's fish self-sufficiency ratio continues to decline as import dependency deepens, from 93% in 2019 to just about 90% in 2022, forcing more seafood imports to meet local demand (Obi *et al.* 2025). To address this shortage and maintain seafood supply, Malaysia increasingly relies on importing fish from other regions, which may involve higher costs, risks related to food safety and quality, and dependence on external sources. Since 2010, Malaysia's seafood import volume has trended upward relative to exports, driven in part by rising consumer preference for imported premium species, reflecting a structural mismatch between depleting local stocks and growing affluent demand (FAO 2026).

While this shifts some pressure away from local fisheries, it can lead to vulnerabilities from global market fluctuations and supply chain disruptions. Overfishing-related income reduction exacerbates poverty by increasing household vulnerability and reducing resilience to economic shocks for small-scale fishers. Other significant implications include increased prices for seafood due to reduced supply and the need to import table fish to secure the country's seafood sufficiency ratio. IUU fishing also contributes to stock depletion and economic losses estimated at billions of Malaysian ringgit, further intensifying poverty risks for small-scale fishers who lack the capacity to compete with larger fishing operations.

GOVERNANCE, POLICY, AND MANAGEMENT CHALLENGES

Marine capture fisheries in Malaysia are in decline, with critical implications for food security, livelihoods, and sustainable development. Overexploitation of coastal and shelf stocks, particularly demersal species along the West Coast of Peninsular Malaysia, has resulted in severe biomass reductions, with historical landings exceeding estimated Maximum Sustainable Yield (Ahmad *et al.* 2003c, Obi *et al*. 2025). This decline reflects a combination of governance, policy, and management deficiencies that have limited the effectiveness of existing interventions.

Governance Challenges

The governance framework for Malaysian fisheries is highly centralised under the Department of Fisheries Malaysia (DOFM), guided by national policies such as the Third National Agricultural Policy (NAP3 1998 – 2010) and the National Agrofood Policy 2021 – 2030 (DAN 2.0). While this structure provides clarity in authority, it has limited mechanisms for stakeholder engagement, particularly for small-scale fishers (Ahmad *et al.* 2003b; Obi *et al.* 2025). Coordination between federal and state authorities is weak, creating silos in management of shared resources such as nearshore waters, islands, and coral reefs (Rahman 2023; Reef Check Malaysia 2025). These governance gaps have hindered the implementation of effective fisheries management measures, enforcement, and long-term strategic planning.

The depth of governance weaknesses is reflected in IUU fishing estimates that have consistently exceeded projections. A 2019 Department of Fisheries Malaysia assessment estimated that IUU fishing accounted for nearly 30% of total marine fish landings, representing a profound enforcement gap relative to the resources deployed for monitoring and control (DOFM 2019). The fisheries sector was worth approximately RM 16.5 billion in 2023, with IUU losses estimated at up to RM 6 billion annually by DOFM, a figure that represents both an economic and ecological burden on the fishery's long-term recovery potential (WWF-Malaysia 2026). Fisheries governance in Malaysia has also been characterised by near-exclusive reliance on input controls such as vessel licensing, gear restrictions, closed areas, and seasonal closures that have demonstrated limited success in addressing persistent overcapacity and compliance failures over the long term (Wong and Yong 2020; Sin *et al*. 2024). The trawler fleet grew from a negligible number in the early 1960s to 4,500 vessels by 1981, with catch per unit effort (CPUE) declining concurrently even as new licences were issued. Without corresponding output controls such as harvest control rules or catch quotas, input restrictions alone cannot prevent stock depletion where fishing capacity systematically exceeds productive limits (Shahrom Abdul Majid 1985).

POLICY CHALLENGES

Policy frameworks have historically prioritised economic growth and commercial expansion, resulting in inequitable distribution of benefits. Large-scale commercial vessels account for approximately 86% of total landings, while small-scale fishers have limited involvement in decision-making, access to markets, and benefit-sharing (Ahmad *et al.* 2003b; Obi *et al.*

2025). National policies, including the National Policy on Biological Diversity 2022 – 2030 (NPBD 2022 – 2030) and the DAN 2.0, acknowledge declining fish stocks and promote sustainability, but gaps in implementation and enforcement persist (Ministry of Natural Resources and Environmental Sustainability 2019; Ministry of Agriculture and Food Industries 2021). Effective policy must therefore address both ecological sustainability and social equity, ensuring that small-scale fishers are empowered to participate in governance and share in the benefits of fisheries.

A further structural challenge lies in the design of fisheries subsidy arrangements, which have historically incentivised the overcapacity and overexploitation that management reforms seek to reverse. Fuel subsidies, extended to small-scale fishers since the 1970s, reduce vessel operating costs and thereby encourage excess fishing effort—accelerating stock depletion and limiting sector modernisation, with compounding risks to long-term food security as stocks continue to decline (WWF-Malaysia 2026). While these schemes were originally designed as poverty alleviation instruments, they have evolved into broadly applied transfer payments with limited evidence of productivity gains, and they align poorly with Malaysia's stated sustainability commitments under the Kunming-Montreal Global Biodiversity Framework and the National Agrofood Policy 2021–2030 (Obi *et al.* 2025; WWF-Malaysia 2026). The reform of fisheries subsidies—redirecting support from fuel and capacity expansion toward enforcement, data systems, and targeted social protection for genuinely vulnerable small-scale fishers—is therefore identified as an essential component of any credible transition to sustainable fisheries management in Malaysia (WWF-Malaysia 2026).

Management challenges

Management deficiencies exacerbate ecological and socio-economic pressures. Chronic overcapacity, proliferation of larger and more powerful vessels, and weak enforcement have contributed to persistent overfishing (Ahmad *et al*. 2003b; Obi *et al*. 2025). IUU fishing, including foreign incursions, imposes significant economic losses, estimated at up to USD 1.3 billion annually (Rahman 2023; Dao 2025). Monitoring and control of fishing effort, catch reporting, and gear compliance remain inadequate due to technical and budgetary constraints (Ahmad *et al*. 2003c; Flewwelling and Hosch 2006). Conflicts between commercial and small-scale fishers, as well as between fisheries, tourism, and conservation interests, further undermine management's effectiveness.

The status of sharks and rays provides one of the sharpest indicators of the broader collapse of Malaysia's marine ecosystem. Malaysia documents at least 65 shark species and 81 ray species, of which at least 22 shark and 41 ray species are classified as threatened with extinction under the IUCN Red List (DOFM 2024b; IUCN 2024). Yet only 11 species receive full protection under the *Fisheries (Control of Endangered Species of Fish) Regulations 1999* (Amendments 2008 and 2019), pursuant to the *Fisheries Act 1985*, thus exposing a critical governance gap. A comprehensive landing site and market survey conducted in Sarawak between January 2017 and December 2019 conservatively estimated that over 26,500 elasmobranchs (approximately 90,000 kg) are locally traded in Sarawak annually, worth approximately USD 125,000 at the market level; endangered and CITES-listed species comprised 26% and 32% of total landings and trade respectively, and high proportions of immature individuals were recorded across conservation-priority species including critically endangered scalloped hammerhead sharks (*Sphyrna lewini*) and bottlenose wedgefish (*Rhynchobatus australiae*) (Booth *et al*. 2021). An electronic camera monitoring programme deployed across trawl vessels in Sabah between 2020 and 2022 estimated that approximately 138,000 sharks and rays are caught as bycatch in Sabah annually, despite no specific fishing licences being issued to target these species, and that approximately 3,500 sea turtles are also incidentally caught each year in the same fisheries (Marine Research Foundation 2024). A 2022 – 2024 study by WWF-Malaysia and partner

universities across five key species found that more than 50% of captured individuals were below their maturity length (L50), providing direct evidence of recruitment overfishing (WWF-Malaysia 2026).

The decline of Malaysian fisheries is driven by interconnected economic, environmental, and social factors. Market demand and technological advances have incentivised overfishing, while population growth and coastal development have increased pressure on nearshore resources (Ahmad *et al.* 2003c). Small-scale fishers, dependent on daily income, often circumvent regulations, highlighting the need for policies that combine enforcement with incentives and alternative livelihood options. Cross-sectoral pressures from tourism, industrial development, and pollution further complicate sustainable management, underscoring the need for integrated, multi-agency approaches.

FUTURE DIRECTIONS FOR SUSTAINABLE FISHERIES IN THE ANTHROPOCENE

Case Studies: Resilience and Regeneration

Fishery Improvement Projects (FIPs) – Marudu Bay, Tun Mustapha Park

Three active Fishery Improvement Projects (FIPs) operating across Malaysian seascapes provide evidence that science-based co-management can be applied across diverse fishery types. The Reef Fishes FIP in Marudu Bay, Tun Mustapha Park, detailed in this chapter, has generated robust biomass data and reduced fish bombing incidents by more than half since 2019 (WWF-Malaysia 2026). The Yellowfin Tuna FIP at Mabul Island, Semporna, launched in 2022, covers approximately 400,000 hectares of Semporna waters impacting around 300 traditional fishers across 16 stakeholder groups including universities and government bodies; Semporna recorded 313 tonnes of yellowfin tuna landings in 2022, among Malaysia's highest volumes, underscoring the economic importance of improving management of this fishery (WWF-Malaysia 2026). The Longtail Tuna FIP at Tok Bali, Kelantan, covers 1.1 million hectares and targets approximately 26 purse seine vessels in a fishery that accounts for 60% of Malaysia's national longtail tuna landings and that has been overfished for at least five consecutive years; WWF-Malaysia is facilitating this FIP with nine stakeholders to develop and implement a strategic action plan to restore healthy longtail tuna stocks and minimise environmental impacts (WWF-Malaysia 2026). Together these three FIPs span reef fish, tuna, and mixed-gear fisheries across three distinct seascapes, demonstrating the model's transferability.

The Reef Fishes Fishery Improvement Program (FIP) in Marudu Bay, Tun Mustapha Park, has become a strong example of ecological, social, and governance resilience since it began in 2019 by gradually transitioning a data-poor, multi-species reef fishery toward science-based co-management. Through a five-year enumerator program in 14 villages, complemented by other stock assessment methods such as Underwater Visual Census and swept area method surveys in 2021, 2022, and 2025, the FIP has generated robust data on fisheries stocks establishing fish biomass and population dynamics for key reef fish families (e.g., snapper, jack/trevally, grouper), enabling the development of reference points using the Beverton Holt yield-per-recruit analysis to develop harvest strategies. At the same time, collective action to curb destructive fishing has reduced fish bombing incidents in Tun Mustapha Park (TMP) by more than half, while annual coral reef health monitoring shows most reef sites in good to moderate condition and ongoing restoration using reef stars and artificial reefs is helping in accelerating recovery. Social and governance resilience have been strengthened through embedded co-management across agencies and communities, with TMP's zonation, community-use areas, and evolving community guidelines such as the Berungus protocol, community use zone supported by the FIP Steering Committee, the TMP Enforcement Plan, and honorary park rangers and wildlife wardens using SMART

patrols and Survey123. Innovative initiatives such as the 2024/2025 shark and ray catch-and-release pilot which released 35 individuals alive and reduced fishing mortality by about two-thirds while generating strong fisher interest illustrate how clear policies, incentives, and continuous engagement can catalyse local stewardship and behaviour change, positioning the Marudu Bay reef fishes FIP as a transferable model for resilient, regenerative reef fisheries in Malaysia and the wider Coral Triangle.

Other Effective area-based Conservation Measure (OECM) — Berungus

The Berungus–Malubang community in Pitas, northern Sabah, has shifted from declining catches to a leading model of community-led marine governance. In the late 1980s, fishers were travelling up to 15 km per trip and spending around 30 litres of fuel daily, signalling worsening stock conditions. After DOF Sabah awareness efforts in the early 2000s, the community began deterring destructive fishing and reporting trawlers and other IUU activities, later partnering with WWF-Malaysia, DOFS, Sabah Parks and the District Office to establish the 1,000 hectares Berungus Marine Managed Area (BMMA) along the Tun Mustapha Park (TMP) boundary, including approximately 70 hectares of no-take zone and a 100-hectare nearshore strip outside TMP under community management. Governance is anchored by the *Protokol Laut Berungus* which was developed since 2018, and a community marine management plan, overseen by a BMMA committee. The protocol sets decision -making rules, FPIC requirements, and safeguards customary tenure and community data sovereignty; the plan operationalises zoning, patrols, IUU reporting, and turtle nest protection.

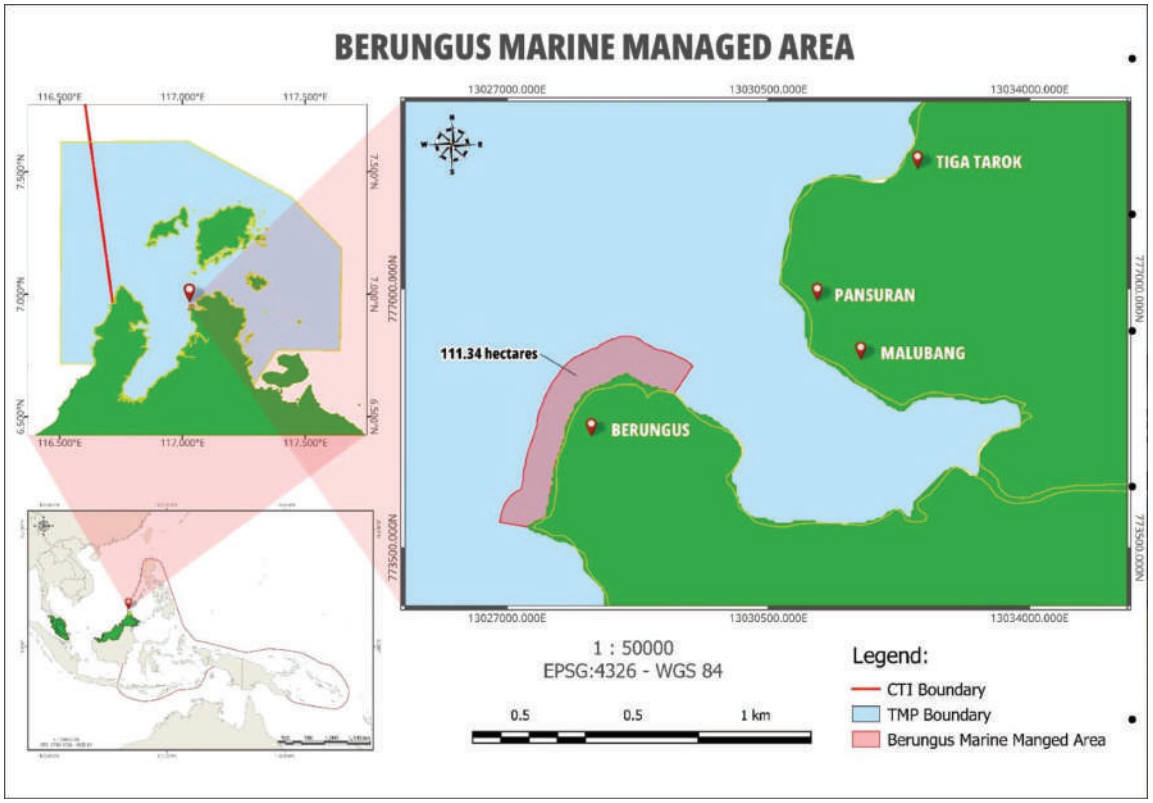

Figure 1. Location of Berungus Marine Managed Area at the boundary of Tun Mustapha Park.

Using daily catch records since 2014 and community knowledge, monitoring indicates average fisher income is 297% higher than the 2014 baseline; surveys also show a 274% increase in reef fish density (2022 – 2025) and stable, moderate live coral cover. Benefits have supported livelihood diversification such as sea cucumber farming, homestays, swiftlet nests, and strengthened TMP by reinforcing the park boundary through community stewardship.

In late 2024, after completing the national OECM assessment, NRES announced Berungus as Malaysia's first coastal and marine OECM candidate; the protocol that is supported by the Pitas Native Court and reinforced by Honorary Wildlife Wardens and an Honorary Park Ranger guides access, consent, data ownership, and benefit-sharing, aligning with national and global biodiversity and seascape commitments.

Small-Scale Fisheries Projects (SSFPs)

Complementing the FIP framework, Small-Scale Fisheries Projects (SSFPs) represent a community-centred approach that explicitly integrates human wellbeing and customary rights into fisheries management planning. Three SSFPs are active or in advanced endorsement stages in Malaysia. The Larapan Island SSFP in Semporna, Sabah (endorsed 2023) covers 200,000 hectares, directly impacting approximately 100 traditional fishers. The Rajang -Belawai-Paloh SSFP in Sarawak (endorsed June 2025) covers 250,000 hectares, supporting approximately 500 traditional fishers across three villages in partnership with the Tanjung Manis District Office. The Kemaman SSFP in Terengganu covers 680,000 hectares and will impact approximately 1,400 traditional fishers in three villages, with the Kemaman Fishers Association and District Fisheries Office as key partners (WWF-Malaysia 2026). Collectively the three SSFPs cover 1.13 million hectares of Malaysian coastal waters. Research confirms that social capital—particularly community networks and leadership—provides a critical bottom-up contribution to the adaptive capacity that these projects seek to build (Bamasood *et al.* 2025).

Artificial reef programme

Habitat-based interventions offer documented potential for partially reversing the socioeconomic impacts of declining catches. A quantitative study of 172 fishermen in Terengganu, where the DOFM has implemented an artificial reef programme specifically designed to protect inshore habitats from trawl damage, found that artificial reef deployment significantly increased fish abundance, reduced the fishing effort required per unit of catch, contributed to higher-value catches, and improved fishermen's household income and socioeconomic status (Sapehee *et al.* 2025). The study further found that 90.7% of respondents were aware of and actively utilised artificial reef sites during fishing, suggesting strong community uptake of this intervention when it is accompanied by effective communication and accessible placement (Sapehee *et al.* 2025). However, equity dimensions require attention: earlier research in Terengganu found that benefits from artificial reefs were not evenly distributed, with larger-engined vessels capturing disproportionate gains, and that gear conflicts within shared artificial reef areas increased fishing costs for smaller operators (Islam *et al*. 2014). Effective artificial reef policy must therefore incorporate user rights frameworks and gear management alongside deployment to ensure equitable benefit-sharing.

Integrating ecological, social, and technological strategies

Malaysia's fisheries sector holds genuine export potential across multiple regions and species categories but realising that potential is contingent on implementing the management reforms outlined in this paper. Stocks currently assessed as overfished or at risk cannot sustain export expansion; the commercial opportunity described below should be read as a recovery dividend, achievable only once the trajectory of stock decline is reversed. On that basis, and with sustainable management as the enabling condition, the export landscape is as follows.

Malaysia's fisheries sector offers significant export potential across multiple regions. On the East Coast of Peninsular Malaysia, opportunities centre on marine fishery products fresh, frozen, and processed alongside shellfish and value-added seafood. Species such as grouper and threadfin are abundant, meeting strong demand for premium seafood in markets like China, Singapore, Japan, and the Middle East. Frozen fish and processed products, including fillets, dried fish, and fish-based snacks, are increasingly attractive to

countries with stringent quality standards such as the EU and the U.S. Terengganu's reputation for blue crabs and shellfish creates further prospects for regional exports to Thailand and Singapore. Rising consumer interest in ready-to-eat seafood supports the development of value-added products such as seafood snacks, fish balls, *keropok lekor*, and pre-cooked meals. Government incentives such as grants, subsidies, and training can help scale up production and aquaculture for export.

In the southern region, fisheries profiles provide detailed data on species availability and quantities, enabling targeted strategies for emerging markets. These profiles inform policy development by addressing overfishing and habitat degradation through data-driven regulations and improved enforcement. They also support research into fish biology and seasonal patterns, guiding sustainable practices and educational programs. Aligning infrastructure development such as ports and processing facilities, with insights from these profiles enhances operational efficiency and sustainability.

The West Coast sector can strengthen economic and ecological resilience through modernisation and conservation. Expanding marine protected areas (MPAs), installing artificial reefs, and diversifying biodiversity safeguard ecosystems while creating opportunities for eco-tourism and higher yields. Targeting high-value species such as green tiger prawns and mantis shrimp can boost income through specialised supply chains. Fleet modernisation with efficient gear and lightweight vessels, coupled with advanced monitoring systems using satellite and artificial intelligence (AI), improves profitability and compliance. Pollution control measures and community engagement further support sustainability.

Sabah, Sarawak, and Labuan hold vast potential for export and innovation. Sabah's tuna resources position it to supply sashimi-grade fish to Japan and the U.S., while Sarawak can diversify into value-added products for Southeast Asian markets. Labuan's offshore fisheries and marine biotechnology initiatives can target premium global markets. These regions can also leverage eco-tourism, community-based management, and marine research to drive growth and conservation. Government support through incentives and training remains critical to enhancing production capacity and competitiveness.

Building resilience to ongoing and future Anthropocene challenges

To reverse the decline of Malaysia's capture fisheries and secure their ecological and socioeconomic viability, a suite of coordinated, adaptive policy measures is required. Evidence consistently shows that the most effective interventions are not isolated enforcement efforts but integrated strategies that combine effort control, spatial management, and participatory governance (Sin *et al.* 2019; Wong *et al.* 2021; Ismail *et al.* 2022).

Effort reduction remains one of the most consistently successful interventions in Malaysia's capture fisheries. Studies of the trawl fisheries along the West Coast and the Indian mackerel fishery in Peninsular Malaysia demonstrate that limiting entry through license caps or buyback schemes increases biomass and catch per unit effort, while improving long-term profitability (Sin *et al*. 2019; Ismail *et al.* 2022). Strengthening the National Fisheries Management Plans with explicit harvest control rules and adaptive seasonal closures would institutionalise evidence-based management. These should incorporate real-time stock data, periodic reassessment of fishing mortality, and integration of local ecological knowledge to ensure adaptive policy responses.

Malaysia's experience with MPAs such as Pulau Payar, Lankayan, and Sibu-Tinggi shows clear ecological gains in fish biomass and coral cover (Teh *et al*. 2008; Fatimah *et al.* 2012; Ariff 2013). However, these benefits are often undermined by weak enforcement and socioeconomic trade-offs that restrict community access (Masud 2015). A national-level MPA framework is needed to integrate marine parks, OECMs, and seasonal closures under

a single spatial management policy. Linking MPAs to fisheries zoning and closed-season regulations (Teh and Teh 2011; Wong *et al.* 2021) will ensure better ecological connectivity and management consistency.

Bottom trawling and other non-selective gears have been identified as major drivers of demersal stock depletion (Yahaya 1988; Wong *et al.* 2021). Empirical studies show that banning trawling in nearshore zones significantly improves juvenile survival rates and helps regenerate degraded habitats (Sin *et al.* 2019). Malaysia's gradual shift toward restricted trawl zones (e.g., Zone B bans) should be accelerated and paired with incentives for gear-switching and retraining. Enforcement agencies such as the Malaysian Maritime Enforcement Agency (MMEA) and Department of Fisheries should coordinate efforts to ensure compliance, backed by clear legal instruments and satellite-based surveillance systems.

Enforcement alone has proven insufficient to secure compliance (Ali and Abdullah 2010). Participatory co-management, which combines local stewardship with regulatory oversight, improves compliance and legitimacy (Ali and Ayob 2005; Masud 2015). Community-based initiatives in Kedah, Perlis, and Mersing show that fisher involvement in monitoring, zoning, and enforcement enhances sustainability (Fatimah *et al.* 2012; Bamasood *et al.* 2025). Institutionalising co-management through national policy, particularly under the Ecosystem Approach to Fisheries Management (EAFM), would empower local groups to participate in decision-making, surveillance, and adaptive management.

Climate-related stressors such as ocean warming, changing currents, and acidification are altering Malaysia's marine productivity and species distributions. Studies emphasise that habitat restoration including mangrove reforestation, coral rehabilitation, and artificial reefs support both climate resilience and fish stock recovery (Saharuddin *et al.* 2012; Ali *et al*. 2013). Integrating climate-smart planning within the Fisheries Master Plan and Marine Spatial Planning (MSP) framework will ensure that stock projections, habitat maps, and sea-level rise scenarios are embedded in decision-making. This approach aligns with global best practices under DAN 2.0 and NPBD 2022 – 2030.

The urgency of embedding climate resilience into fisheries recovery planning has intensified significantly following the 2024 mass bleaching event, the fourth and most widespread global bleaching event in recorded history (NOAA Coral Reef Watch 2026). The 2025 national reef survey by Reef Check Malaysia, covering 297 sites from the tourist -heavy peninsula islands to remote Sabah waters which documented average live coral cover falling to just under 40%, a 20% decline from 50% in 2022 (Reef Check Malaysia 2026). Over four-fifths of surveyed reef sites showed signs of abandoned fishing gear or trash, and more than half bore anchor damage; in parts of Sabah, dynamite fishing damage was recorded at one-third of sites (Reef Check Malaysia 2026).

Since coral reefs function as the nursery and feeding infrastructure underwriting small-scale fisheries productivity, supporting over 140,000 small-scale fisher households in Malaysia—this trajectory of habitat loss must be treated as a fisheries management emergency, not merely a biodiversity concern (Reef Check Malaysia 2026). Recovery strategies combining marine protected area expansion, active coral restoration using the MARRS system (which has rehabilitated 2,122 m^2 in Tun Mustapha Park), and strict enforcement against anchor damage and abandoned gear offer the most evidence-grounded pathway to rebuilding the reef habitat on which fish stock recovery depends (WWF-Malaysia 2026).

Weak data collection remains a systemic challenge. Research advocates for the use of digital monitoring technologies such as vessel monitoring systems (VMS), electronic logbooks, and AI-assisted remote sensing to improve transparency and adaptive management

(Wong *et al*. 2021; Ismail *et al.* 2022). Incorporating these tools into DOFM's monitoring systems would enable real-time tracking of fishing effort and support enforcement coordination. Establishing a centralised national fisheries data platform—integrated across agencies and open for scientific use—would improve stock assessments, subsidy accountability, and value chain transparency.

Fisheries governance in Malaysia remains fragmented across ministries and jurisdictions, limiting cohesive responses to transboundary issues such as IUU fishing and migratory stock management (Yahaya 1988; Saharuddin *et al.* 2012). Establishing a National Fisheries Coordination Council could improve alignment between DOFM, MMEA, Ministry of Finance (MOF), Ministry of Investment, Trade and Industry (MITI), and state governments. At the regional level, Malaysia should strengthen collaboration under the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF) and ASEAN mechanisms to harmonise vessel monitoring, share enforcement data, and jointly manage shared stocks such as tuna and small pelagic (Teh and Teh 2011; Bamasood *et al.* 2025). Coordinated transboundary governance is essential to achieving ecological sustainability and economic resilience in an era of rapid environmental change.

CONCLUSION

The decline of Malaysia's capture fisheries is not a crisis in the making, it is a crisis already arrived. What the evidence assembled in this paper reveals is a pattern of systemic failure: a fisheries management architecture built on input controls that have consistently proven insufficient to arrest overcapacity; governance fragmented across ministries, agencies, and federal-state jurisdictions that leaves shared resources without coherent stewardship; subsidy arrangements that incentivise the very excess effort they were never designed to produce; and an enforcement gap so wide that nearly 30% of total marine landings are estimated to occur outside the legal framework altogether (DOFM 2019). These are not technical deficiencies awaiting a technical fix. They are structural features of a governance system that has, over decades, consistently prioritised short-term production over long-term sustainability. The ecological bill is now coming due simultaneously from overfishing and a changing climate that is degrading the reef, mangrove, and seagrass habitats on which fish stock recovery ultimately depends.

The human consequences of this structural failure fall hardest on those least responsible for it. Small-scale fishers who represent the majority of the fishing workforce yet account for only 35% of landings bear the most immediate costs of stock depletion, habitat loss, and coastal development, with limited access to financial services, alternative livelihoods, or meaningful participation in the governance processes that determine their futures (Bamasood *et al*. 2025). The continued exclusion of fishing communities from fisheries decision-making is not simply an equity concern; it is a management failure, because durable recovery will be impossible without the active stewardship of the people who know these waters best and depend on them most directly.

Yet this paper also documents that recovery is achievable. The Berungus Marine Managed Area, Malaysia's first coastal and marine OECM candidate, demonstrates what becomes possible when communities are given formal rights, clear responsibilities, and consistent institutional support: fish density up 274%, fisher incomes up 297% above baseline, and a governance model grounded in customary law and co-management that is now being recognised at the national level (WWF-Malaysia 2026). The three active Fishery Improvement Projects and three Small-Scale Fisheries Projects detailed in this paper spanning reef fish, tuna, and mixed-gear fisheries across Sabah, Sarawak, and East coast of

Peninsular Malaysia show that science-based co-management is transferable across fishery types and seascapes. These are not experiments; they are working models. The challenge is to move them from the margins to the mainstream of Malaysian fisheries governance.

Doing so will require changes of a different order than those Malaysia has historically been willing to make. Output controls such as harvest control rules, catch quotas, and adaptive seasonal closures grounded in real-time stock data must complement and eventually supersede the input controls that have defined management for four decades. The legal protection gap for sharks and rays, the species most sensitive to fishing pressure and most indicative of ecosystem health, must be closed. Fisheries subsidies must be restructured away from fuel and vessel capacity expansion and toward enforcement, monitoring, gear transition, and targeted social protection. Marine spatial planning must be scaled from seascape-level pilots to a nationally coherent, enforceable framework that integrates marine parks, OECMs, fisheries zones, and climate projections into a unified spatial management architecture. Malaysia must invest in the digital monitoring infrastructure such as vessel monitoring systems, electronic logbooks, and real-time surveillance that effective enforcement and adaptive management require (Wong *et al*. 2021; Ismail *et al*. 2022).

None of this is beyond Malaysia's capacity. The knowledge, the community models, and the scientific data needed to chart a recovery trajectory already exist within Malaysian waters and institutions. What has been missing is the political will to embed these approaches within national policy and the institutional capacity to implement them consistently across the country's diverse coastal seascapes. Malaysia's commitments under the Kunming -Montreal Global Biodiversity Framework including the 30×30 ocean protection target and the National Agrofood Policy 2021 – 2030 provide the policy architecture within which these changes can be anchored. The question is whether the urgency that the data demand will translate into the action that the fisheries, and the people who depend on them, now urgently require.

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