Chapter 5 Fish, Fisheries and Aquaculture

"Implementing the Strategic Action Programme for the South China Sea and Gulf of Thailand (SCS SAP Project)"

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Abstract

Cambodia's fisheries and aquaculture remain central to national food security, livelihoods, and coastal economies, but available indicators show that ecological limits have been exceeded and recovery capacity is challenging. Marine production is highly concentrated: the four coastal provinces contribute roughly one quarter of national catch, with Preah Sihanouk and Koh Kong supplying the majority of marine landings. The marine sector is strongly trawl-dependent—trawls and purse seines together account for most landings, with bottom trawls alone contributing over half—while the fleet is predominantly small-scale, informal, and weakly regulated, with very low vessel registration and most engines below 50 HP. Stock and ecosystem indicators consistently signal severe depletion: demersal trawl CPUE has fallen from historical levels to around 26 kg/hour in recent surveys, and stock-status reconstructions show a long-term shift toward over-exploited and collapsed stocks. Ecosystem indices (MTI, FiB and PPR) indicate "fishing down the food web" and harvest levels operating at or beyond ecological carrying capacity. Aquaculture has expanded rapidly over recent decades, dominated by freshwater systems, but coastal aquaculture has recently contracted sharply and become more spatially concentrated, increasing livelihood risk in coastal provinces. These pressures are transboundary: shared stocks, cross-border fishing and IUU activity, habitat degradation, and pollution-driven impacts interact with climate change (warming, sea-level rise, altered hydrology) to compound risks. The chapter concludes with priority actions focused on rebuilding stocks through effort reduction and improved selectivity, protecting critical habitats, strengthening MCS and co-management, modernizing fisheries information systems, and deepening regional cooperation on stock assessment, harmonized standards, and coordinated enforcement.

Keywords: *Cambodia, Fisheries; Aquaculture; Overfishing; Stock depletion; CPUE; Bottom trawling; IUU fishing; Ecosystem indicators (MTI, FiB, PPR); Marine protected areas/MFMA; Monitoring, Control and Surveillance (MCS); Gulf of Thailand; Climate change impacts; Co-management; Regional cooperation.*

5. Fish, Fisheries and Aquaculture

5.1 Key Findings

- **Marine production is highly concentrated and ecologically imbalanced.** The four coastal provinces produce ~25% of national catch, with Preah Sihanouk and Koh Kong supplying 75–80%. Demersal species dominate, while sharks and rays have collapsed to single-digit tonnes.
- **Aquaculture is expanding but uneven.** Farmed output grew from 4 tonnes (1976) to 330,600 tonnes (2022), mostly freshwater. Coastal aquaculture fell sharply—from 35,460 t (2020) to 16,499 tonnes (2024)—and is now dominated by Koh Kong.
- **The fleet is largely small-scale and trawl-dependent.** In 2018, 7,552 vessels were recorded—97% unregistered and 89% under 50 HP. Trawls and purse seines generate 85–90% of landings, with bottom trawls alone contributing 55–60%.
- **CPUE and stock indicators show severe depletion.** Demersal trawl CPUE has dropped from 173 kg/hr (1960s) to ~26 kg/hr, and stock-status plots show over-exploited and collapsed stocks dominating landings.
- **Ecosystem indices show limits have been exceeded.** MTI fell from ~3.8 to ~3.5; FiB peaked near 3.0 then declined; PPR exceeded 2.0 during 1990–2010—clear signs of fishing shifting to lower-trophic species and surpassing ecological capacity.
- **Past subsidies accelerated over-capacity.** In 2003, 60% of ~USD 29 million in subsidies were capacity-enhancing (ratio 0.12). Although reduced later, these incentives, combined with weak registration and heavy trawl use, helped drive chronic over-exploitation.

5.2 Current Status of Fisheries and Ecosystem Health

5.2.1 Current Status of Fisheries

5.2.1.1 Annual catch/capture fisheries production

a) Catch quantity (tonnes)

According to FAO FishStatJ (1950–2022), as shown in Figure 5-1, Cambodia's total capture fisheries increased from about 35,000 tonnes in 1960 to a peak of 656,105 tonnes in 2018, before easing to 533,450 tonnes in 2022 (FAO FishStatJ, 2024).

Inland fisheries have consistently provided 70–75% of national catch, rising from 29,100 tonnes in 1960 to around 402,205 tonnes in 2022, driven by the Tonle Sap–Mekong floodplain system and expansion of community fisheries (FiA, 2025).

Marine capture grew more modestly—from 5,900 tonnes in 1960 to 131,245 tonnes in 2022—with the four coastal provinces now contributing roughly one quarter of national production. The long-term trajectory reflects improved reporting, fleet motorization and post-1999 structural growth, but also mounting pressure on coastal and inland ecosystems, reinforcing the need for stronger co-management and data-based regulation.

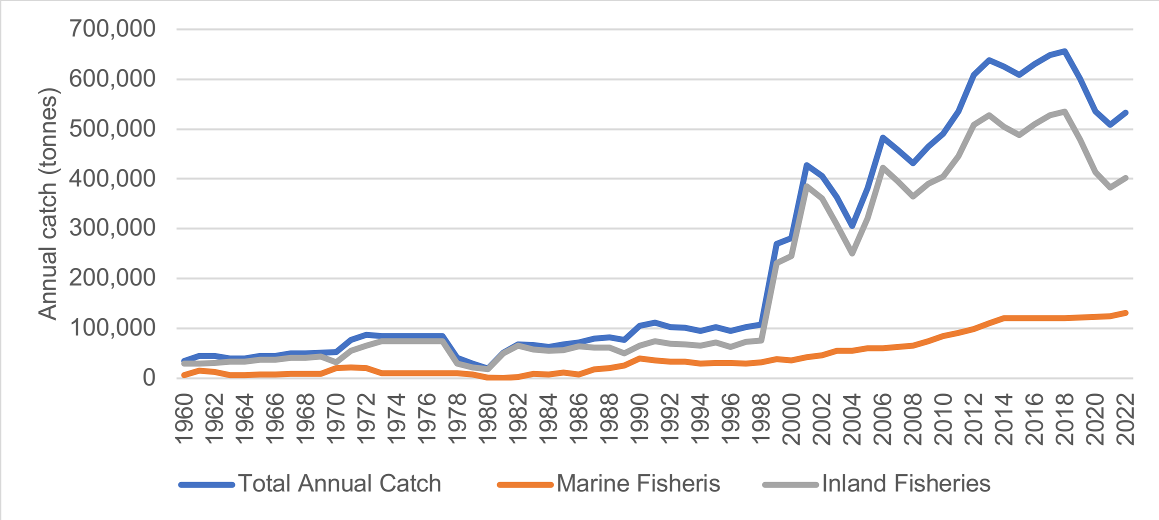

Figure 5-1 Capture fisheries production in Cambodia, 1960–2022 (total vs. marine vs. inland)

***(Source:** FAO FishStatJ, 2024)*

FiA data (Table 5-1) show coastal marine production rising from about 91,000 tonnes in 2011 to 139,310 tonnes in 2024—a 53% increase overall (FiA, 2025). Nearly all landings came from the four coastal provinces, with Preah Sihanouk remained the top producer (≈45,000–57,000 tonnes/year), driven by trawl and purse-seine fleets and expanded port capacity. Koh Kong increased from 40,100 tonnes (2012) to 53,470 tonnes (2024), while Kampot showed seasonal fluctuations linked to inshore gear rules. Kep's small-scale fishery grew from 1,400 tonnes (2016) to 4,430 tonnes (2024).

Table 5-1 Marine capture by provinces (national series) – tonnes

Year	Coastal province	Kep	Kampot	Preah Sihanouk	Koh Kong
2011	91,000	…	…	…	…
2012	99,000	…	11,100	47,800	40,100
2013	110,000	…	19,500	49,000	41,500
2014	120,250	…	16,789	55,819	47,642
2015	110,000	…	12,000	50,000	48,000
2016	120,600	1,370	23,180	46,000	50,050
2017	121,025	1,400	21,645	47,790	50,190
2018	121,100	1,410	21,660	47,820	50,210
2019	121,250	4,315	23,509	45,266	48,160
2020	122,700	5,253	20,300	44,598	52,549
2021	125,000	5,657	18,708	47,410	53,225
2022	125,200	2,530	22,740	49,550	50,380
2023	125,500	2,620	22,080	50,400	50,400
2024	139,310	4,430	24,400	57,010	53,470

Source: FiA's *Annual Fisheries Statistical Report (2012–2024)*

b) Catch value (US$ 1,000)

In recent years, Cambodia's marine fisheries production value has stabilized around USD 190–200 million, contributing roughly one quarter of total national fisheries value, underscoring the sector's continued economic importance despite signs of ecological pressure and resource decline (FAO FishStatJ, 2024). Moreover, reconstructed catch value rose with expansion, peaking near US$449.7M (2008); values later dipped to US$245.2M (2019), tracking FiB's volatility and lower-trophic reliance (Sea Around Us (SAU), 2024).

5.2.1.2 Species Population Size (marine capture fisheries)

Figure 5-2 summarizes long-term trends for Cambodia's main marine species groups based on reconstructed Sea Around Us (1960–2019) catch data. The data shows:

Perch-likes (demersal/reef finfish): Increased from about 8,700 tonnes in 1960 to a peak of ~188,000 tonnes in 1999, then declined to 97,000–123,000 tonnes in 2014–2019. They still make up roughly half of recent marine catch, reflecting high dependence on mixed demersal fisheries.

Crustaceans (shrimps, crabs): Rose from 2,800 tonnes in 1960 to ~50,000–54,000 tonnes in 2000–2002, easing to 30,000–37,000 tonnes by 2015–2019 due to nursery-ground degradation, gear controls and market shifts.

Herring-likes (small pelagics): Grew from 700 tonnes in 1960 to 22,000–32,000 tonnes in 1999–2002, then declined to 6,000–9,000 tonnes in 2013–2019, indicating early over-expansion and later stock depletion.

Anchovies: Increased from 700 tonnes in 1960 to ~22,000–23,000 tonnes in 2003–2005, falling to 8,000–10,000 tonnes in 2013–2019, mirroring the broader contraction of small pelagics.

Molluscs (cephalopods, bivalves): Virtually absent in early decades, rising to 24,000–32,000 tonnes in 1999–2001 and normalizing at 11,000–12,000 tonnes by 2018–2019 following cyclical targeting and variable availability.

Scorpionfishes: Reached 9,000–10,000 tonnes in the mid-1980s, then dropped to under 1,000 tonnes after 2010 due to depletion of nearshore reefs.

Sharks and rays: Collapsed from 2,000–4,000 tonnes in 2000–2003 to below 100 tonnes after 2010 and only single-digit tonnes by 2018–2019, reflecting severe long-term depletion.

Other fishes and invertebrates: Increased from 2,900 tonnes in 1960 to ~74,000 tonnes around 2000, then stabilized at 30,000–35,000 tonnes in 2013–2019, representing diverse nearshore multispecies catches for domestic markets.

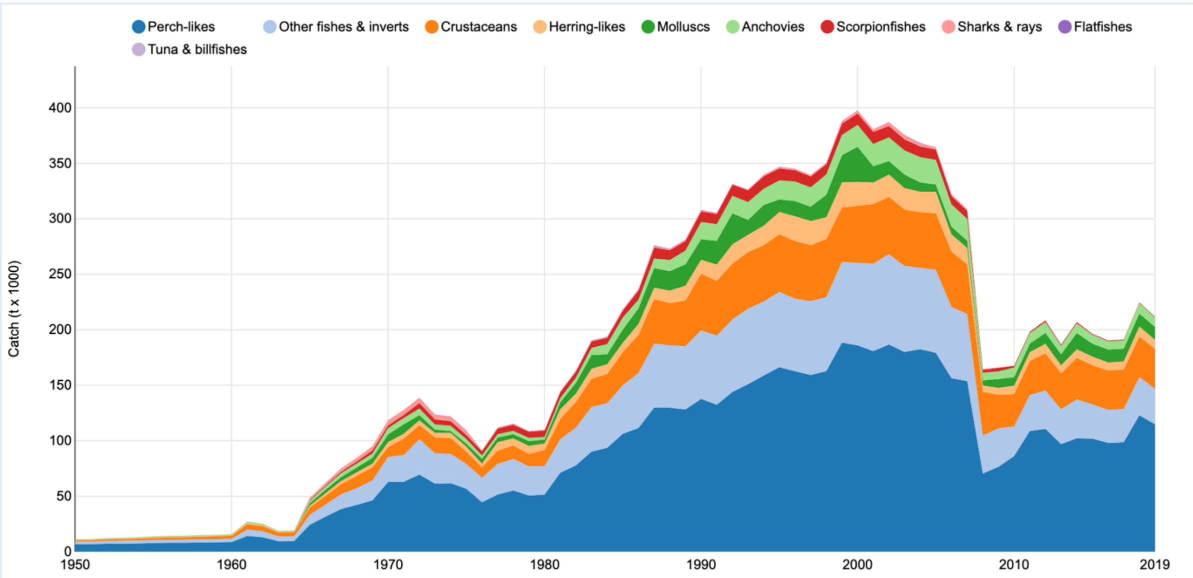

Figure 5-2 Catches by commercial groups in the waters of Cambodia (1950-2019)

Source: *Sea Around Us (SAU), 2024. Cambodia marine species group production, 1950–2019*

5.2.1.3 Aquaculture Production

a) Aquaculture production: levels and trends (1976–2022)

Nationally, Cambodia's aquaculture expanded from 4 tonnes in 1976 to 330,600 tonnes in 2022, peaking at 400,400 tonnes in 2020 (FAO FishStatJ). Freshwater systems dominate, rising to 314,310 tonnes in 2022 and supplying about 95% of national output in recent years. Marine and brackishwater volumes remain small—~14,900 tonnes and ~1,400 tonnes in 2022—but marine farming has grown to 15,000–18,000 tonnes (around 4–5%) during 2020–2022). Marine production centres on cage-cultured finfish (groupers, Asian seabass) and oysters along Koh Kong, Preah Sihanouk and Kampot, aligning with regional classifications of Cambodia as predominantly freshwater-aquaculture (SEAFDEC; Kunthy, 2021).

In the most recent three years (Table 5-3), FiA's Annual Fisheries Statistical Report 2020–2024 show a major contraction in coastal aquaculture, dropping from 35,460 t in 2020 to 16,499 t in 2024 (-53%). The steepest decline occurred in 2022–2023 (-46%), with only a modest rebound in 2024. Losses were strongest in Kampot (-74%) and Preah Sihanouk (-69%), while Koh Kong fell less sharply (-37%)—increasingly dominated production. By 2024, Koh Kong accounted for nearly 68% of coastal output, up from 50% in 2020, highlighting both a severe overall downturn and growing spatial concentration of the sector (FiA, 2020–2024).

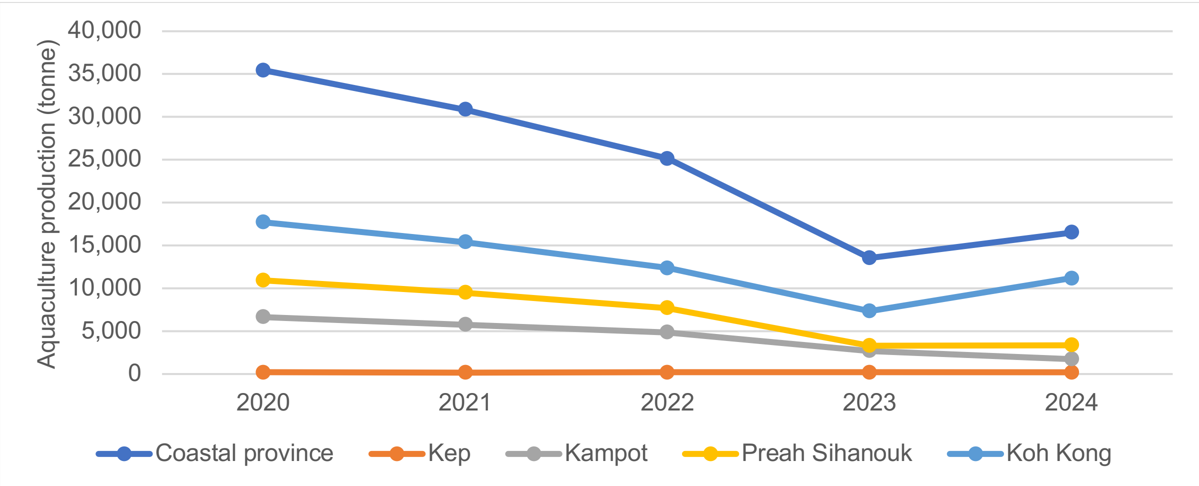

Figure 5-3 Coastal provinces aquaculture trend (2020–2024)

Source: FiA (Cambodia). *Annual Fisheries Statistical Report (2020–2024)*

b) Aquaculture value (USD) and unit values

FAO data show farmed production value rising from USD 2.54 million in 1984 to a peak of USD 1.209 billion in 2020, then easing to USD 1.052 billion (2021) and USD 998.9 million (2022) (FAO FishStatJ, 2025). Unit values remained stable at ~USD 3,000/t from 2018–2022, indicating that recent value declines reflect lower volumes, not price changes. This national trend aligns with a rapidly growing global aquaculture sector, with 2022 marking the first year farmed aquatic-animal output surpassed wild capture, reaching 223.2 million tonnes (SOFIA 2024; FAO). See Annex Table 5-5 for full series and more detail.

5.2.1.4 Annual marine catch by types of gear

Cambodia's marine fisheries have industrialized over time, shifting from mainly artisanal gears to a trawl-dominated sector from the mid-1980s, with some rebound of small-scale gears after 2005. Trawls now account for about 55–60% of marine catch and purse seines 30–35%, mirroring wider Gulf of Thailand trends. Trawl landings grew from <1,000 t in the 1960s to a peak of ~181,000 t in 2002, then levelled at ~118,000–138,000 t, consistent with capacity saturation and zoning controls, but with significant benthic and demersal impacts. Purse-seine catches rose to ~191,500 t in 2000 before moderating to ~53,000–67,000 t per year as small pelagic stocks and regulations tightened. Small-scale gears (gillnets, traps, handlines) now contribute about 10% of landings but remain critical for food security and livelihoods, while other minor gears together provide <1% of marine catch. For more detail, see supplementary material in Annex Table 5-4.

Table 5-2 Marine catches by gear type in Cambodian waters (tonnes & %)

Year	Trawl		Purse seine		Small-scale		Others	
	Tonne	%	Tonne	%	Tonne	%	Tonne	%
1960	0	0.0%	0	0.0%	15,900	100.0%	1	0.0%
1970	71,875	60.6%	33,463	28.2%	13,227	11.2%	6	0.0%
1980	59,144	53.8%	38,878	35.4%	11,888	10.8%	6	0.0%
1990	153,674	49.9%	108,375	35.2%	45,622	14.8%	523	0.2%
2000	174,434	43.9%	191,546	48.2%	30,148	7.6%	1,448	0.4%
2010	92,606	55.3%	57,656	34.4%	15,677	9.4%	1,612	1.0%
2019	128,483	60.7%	63,634	30.1%	17,644	8.3%	1,986	0.9%

Source: *Sea Around Us (SAU), 2024. Catches by Gear in the waters of Cambodia (computed by author)*

5.2.1.5 Number of marine fishing vessels

FiA's 2018 marine vessel census (Table 5-3) recorded 7,552 fishing vessels across the four coastal provinces, confirming a predominantly small- and medium-scale fleet. Small-scale boats made up 53% of all vessels (4,030 units), while medium-scale vessels accounted for 47% (3,512 units). Only 10 vessels ≥24m were identified, indicating a very limited industrial fleet. The fleet is geographically concentrated: Koh Kong held 45% of all vessels (3,396 units), followed by Preah Sihanouk 33%, Kampot 14%, and Kep 8%. Koh Kong's dominance reflects its extensive coastline and long-established trawl and gill-net fleets, while Kampot and Kep remain largely artisanal.

Table 5-3 Number of marine fishing vessels: large, medium, and small scale

Vessel Type (Ranking m)	Koh Kong	Preah Sihanouk	Kampot	Kep	Total
Large Scale (≥ 24 m)	10	0	0	0	10
Medium Scale (12 ≤ 24)	962	1,545	629	367	3,512
Small Scale (< 12 m)	2,424	978	410	227	4,030
Total	**3,396**	**2,523**	**1,039**	**594**	**7552**

Source: *FiA, MAFF. Marine Fishing Vessel and Licensing Database.*

Vessel classification (Table 5-4) by engine power confirms the small-scale character of the fleet: approximately 6,699 vessels (89 %) were under 50 HP, with only a small minority exceeding 90 HP. This pattern suggests limited offshore capability and strong dependence on coastal and inshore fishing grounds. The few higher-horsepower vessels (181–540 HP) are mainly trawlers and purse-seiners operating from Koh Kong and Preah Sihanouk.

Table 5-4 Number of marine fishing vessels by engine power

Type of Engine Power (HP)	Koh Kong	Preah Sihanouk	Kampot	Kep	Total
< 50	2,967	2,115	1,028	589	6,699
51 – 90	157	110	7	7	279
91 – 180	179	257	4	0	440
181 – 270	57	26	0	0	83
271 – 540	36	15	0	0	51
Total	**3,396**	**2,523**	**1,039**	**594**	**7552**

Source: FiA, MAFF. Marine Fishing Vessel and Licensing Database.

Table 5-5 shows that of the 7,552 vessels enumerated, 97% were non-registered, and only 3% held valid registration. This extremely low compliance rate underscores persistent governance challenges, including inadequate enforcement capacity, outdated vessel records, and the prevalence of informal operations. The predominance of unregistered craft complicates management of fishing effort and hinders the implementation of licensing and monitoring systems essential for sustainable fisheries management.

Table 5-5 Number of registered and non-registered marine fishing vessels

Registration Status	Koh Kong	Preah Sihanouk	Kampot	Kep	Total	%
Non-Registered	3,217	2,469	1,039	593	7,318	97
Registered	191	41	2	0	234	3
Total	**3,408**	**2,510**	**1,041**	**593**	**7,552**	100

Source: *FiA, MAFF. Marine Fishing Vessel and Licensing Database.*

Furthermore, the FAO-CAPFISH MaFReDI Fish Catch Monitoring Manual (2021) reported that about 1,100 trawl vessels under 12m are active, making trawling a dominant gear among small-scale fishers. Approximately 50 % of vessels operate multiple gears, complicating catch monitoring and management (FiA, 2021).

5.2.1.6 Catch Effort and CPUE

Vessel census data indicate thousands of small- and medium-scale boats, with limited large-scale units; however, consistent CPUE time series for bottom trawl in Cambodia's waters remain sparse. Available snapshots show mid-scale trawl CPUE around ~252 kg/day, with gear-specific CPUEs for gillnets/traps ranging ~7–148 kg/day, underscoring high variability across fleets and habitats (MaFReDI technical report cited by FiA; see FiA FIMS portal). Historical trawl surveys show demersal catch-per-unit-effort (CPUE) falling from about 173 kg/hour in 1966 to 21 kg/hour in 1995, reflecting an estimated 80–90 % reduction in demersal fishable biomass across the region (SEAFDEC, 2019). Recent joint Thai–Cambodian surveys (2019) reported CPUE levels of only 26.27 kg/hour in Cambodian waters, indicating continued depletion of bottom fish stocks (SEAFDEC, 2019).

5.2.1.7 Subsidies

Based on Sea Around Us (SAUP) subsidy data as shown in Table 5-6, Cambodia received an estimated US$28.98 million in fisheries subsidies in 2003, of which ~US$17.5 million (≈60%) were capacity-enhancing (mainly vessel modernization and development support). With a marine catch value of ~US$145 million, the capacity-enhancing subsidy-to-landed-value ratio was 0.12—a relatively high level by global standards, indicating strong state-driven expansion of fishing capacity. By 2009, total subsidies had fallen sharply to US$4.05 million, with only US$0.69 million (≈17%) capacity-enhancing, lowering the ratio to 0.005. This shift reflects a move away from direct fleet expansion toward management, community support and R&D, though the earlier high subsidies contributed to long-term pressure on marine ecosystems.

Table 5-6 Capacity-Enhancing Subsidies and Landed-Value Ratios in Cambodian Marine Fisheries

Year	Total Fisheries Subsidies (US$ million)	Capacity-Enhancing Subsidies* (US$ million)	Marine Catch Value (US$ million, FAO)	Ratio (Capacity-Enhancing Subsidy / Landed Value)	Notes
2003	28.98	17.47	145.7	0.12	High capacity-enhancing share (fleet modernization, development support); reflects expansion phase
2009	4.05	0.69	148.0	0.005	Sharp contraction; policy shift toward management and R&D support

Source: Pauly & Zeller (2020) – Sea Around Us Global Fisheries Subsidies Database (1950–2019)

5.2.2 Current Status of Ecosystem-health

5.2.2.1 Stock-status plots

Cambodia's marine fisheries have moved from developing to heavily exploited and increasingly collapsed conditions. Stock-status plots (Figure 5-4), show a clear long-term shift from healthy "Developing" stocks to growing shares of Over-exploited and Collapsed stocks, indicating a fishery under severe ecological stress.

- **Phase 1 – Developing (1950s–early 1970s):** Over 95% of catch came from developing stocks, reflecting low fishing pressure and abundant resources.
- **Phase 2 – Fully exploited (1970s–1980s):** The share of exploited stocks rose rapidly—from <1% in the mid-1960s to ~19% by 1970, stabilizing around 10–12%—as effort expanded to sustainable limits.
- **Phase 3 – Over-exploitation & collapse (1990s–present):** Over-exploited stocks increased to 10–15% of catch by 2010, collapsed stocks to 5–6% by the late 2010s, and more than half of assessed stocks were collapsed by 2018–2019, highlighting widespread depletion and low recovery potential.

Overall, the stock trajectory signals a shift from underutilization to chronic overfishing and ecosystem stress. The near absence of developing or rebuilding stocks points to limited recruitment and recovery, underscoring the need for rebuilding plans, habitat restoration, and stricter trawl and bycatch management to sustain Cambodia's marine fisheries.

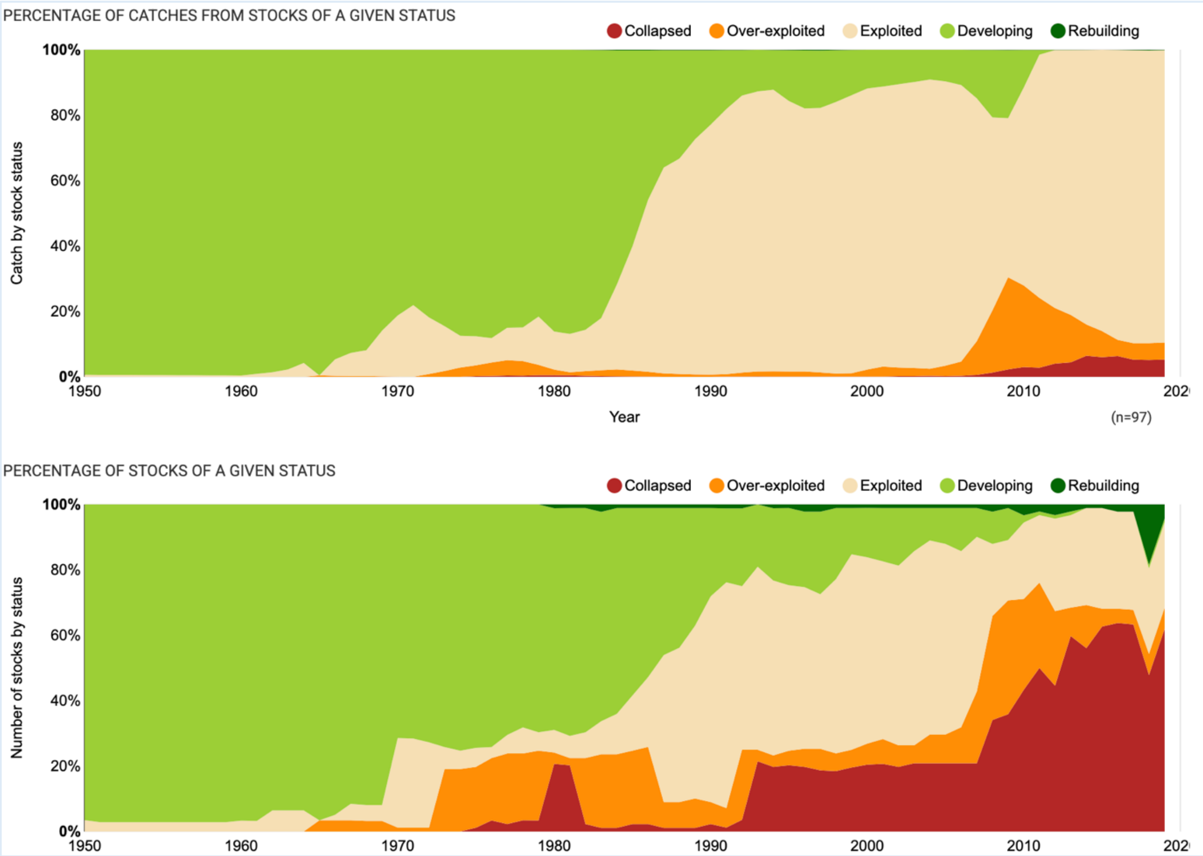

Figure 5-4 Stock status in the waters of Cambodia (1950–2019)

Source: *Sea Around Us (SAUP):* https://www.seaaroundus.org/data/#/eez/116/stock-status

5.2.2.2 Marine Trophic Index (MTI) and FiB index

MTI and the FiB trends, the data from SAUP – as shown in **Error! Reference source not found.**, show that Cambodia's marine ecosystem has shifted toward lower-trophic, less resilient species under sustained fishing pressure. The **MTI** declined from ~3.83 in the 1950s to ~3.47 by the early 1990s, reflecting the loss of large predators and clear "fishing down the food web." Since the 1990s, MTI has fluctuated at a lower level (3.50–3.57), indicating continued dependence on small pelagics and invertebrates. The **FiB Index** rose steadily to a peak of 2.97 in 2002, showing that catches were maintained by expanding effort and targeting lower-trophic species. After 2008, the FiB index dropped sharply to 2.08 and became volatile, signaling that ecological limits to expansion had been reached.

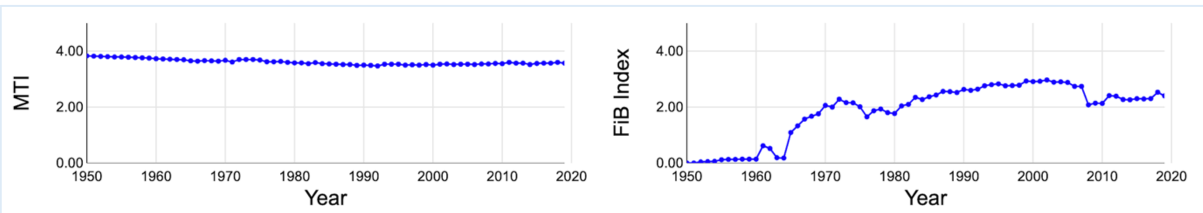

Figure 5-5 Mean trophic level (Marine Trophic Index or MTI) and FiB index in Cambodian waters

Source: *Sea Around Us (SAU)*

Together, MTI and FiB trends indicate a heavily pressured and simplified marine ecosystem, with declining recovery potential and growing risk unless stock rebuilding, habitat protection and effort-reduction measures are strengthened.

5.2.2.3 Primary Production Required (PPR)

PPR measures how much of the ocean's primary productivity is needed to support fisheries. Cambodia's fisheries operated well within ecological limits until the early 1970s (Figure 5-6), with PPR < 1.0**.** From the late 1970s onward, however, PPR rose sharply, peaking at 2.30 in the early 2000s**,** meaning fishing required more than twice the primary production available—clear evidence of overexploitation. Despite Cambodia's naturally productive EEZ (47,676 km²) and inshore fishing area (22,666 km²), with an estimated primary production rate of 652.71 mgC/m²/day, persistently high PPR values (especially 1990–2010**)** show that harvest levels exceeded the system's regenerative capacity. The footprint also reflects substantial foreign-fleet pressure, underscoring the transboundary nature of ecosystem stress. Overall, PPR trends signal an ecosystem operating at or beyond its limits, reinforcing the need for reduced effort, stronger stock management and regional cooperation.

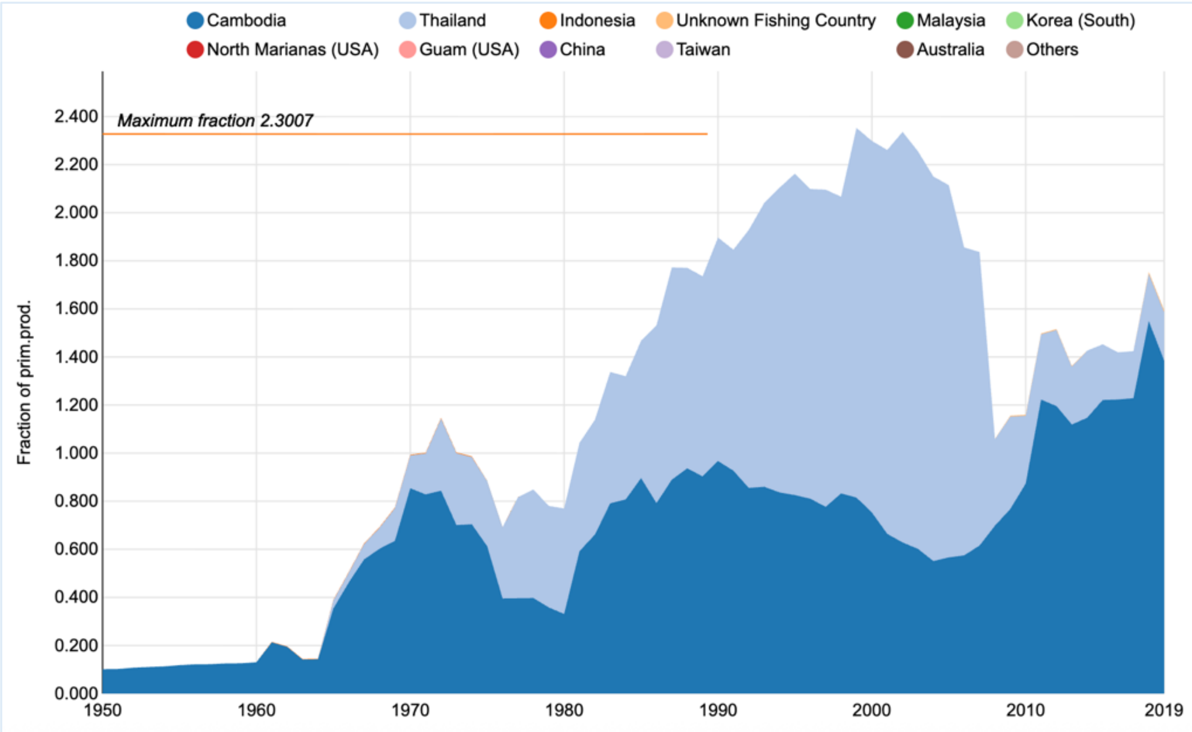

Figure 5-6 Primary Production Required for catches in the waters of Cambodia
Source: *Sea Around Us (SAU)*

5.2.2.4 Fish Biomass

Cambodia lacks nationwide biomass estimates, but all available evidence points to severe long-term depletion. Historical SEAFDEC trawl surveys show demersal CPUE falling from 173 kg/hour (1966) to 21 kg/hour (1995)—an 80–90% biomass loss—with a joint Thai–Cambodian survey in 2019 confirming low levels (26.27 kg/hour). Sea Around Us indicators similarly show that by the 1990s over 70% of assessed stocks were over-exploited or collapsed, accompanied by declining MTI and unstable FiB values.

Site-level studies at Koh Rong and Koh Sdach report reef-fish communities dominated by small planktivores and herbivores, with few large predators remaining. Inland systems mirror this pattern: better-governed Community Fish Refuges maintain higher biomass, while open-access areas show rapid decline. Overall, both marine and inland fisheries face critical biomass pressure, highlighting the need for systematic monitoring and adaptive co-management.

5.2.2.5 Catch from Bottom Impacting Gear

Bottom trawling remains the dominant gear, generating 55–60% of marine landings but causing extensive habitat damage. Continuous seabed contact degrades coral, seagrass and nursery grounds, resuspends sediments, and contributes to long-term productivity decline—reflected in the Marine Trophic Index drop from 3.83 (1960) → 3.47 (1992) and only partial stabilization since.

Despite relatively high trawl CPUE (~252 kg/day in 2023) on shallow shelves of Kampot, Preah Sihanouk and Koh Kong, catches are increasingly dominated by juveniles and low-value species. “Trash fish” now account for 35–45% of trawl landings, much of it used for fishmeal, reflecting intense juvenile removal and fishing-down-the-food-web trends. Stock-status plots show rising overexploitation since the 1990s. Strengthened trawl management—spatial controls, selective gear, and improved bycatch monitoring—is essential to reduce ecological damage and support stock recovery.

5.3 Discussion and Conclusions

5.3.1 Transboundary problems, issues and risk assessment

5.3.1.1 Overexploitation and Stock Depletion

Stock-status reconstructions and CPUE trends confirm a long-term regional decline. By the late 2010s, over half of assessed stocks were classified as over-exploited or collapsed, demersal-trawl CPUE had fallen by roughly 80–90 % from 1960s levels, and the Marine Trophic Index dropped from 3.8 to 3.5 (SEAFDEC, 2019; Pauly & Zeller, 2020). These patterns transcend national jurisdictions: migratory small pelagics and demersal fishes move freely across EEZ boundaries, while foreign industrial fleets have historically accounted for a substantial fraction of fishing effort in Cambodian waters. This is reflected in high Primary Production Required (PPR) values exceeding 2.0 between 1990–2010, indicating exploitation beyond the ecological carrying capacity (Sea Around Us, 2024).

5.3.1.2 Shared Stocks and Cross-Border Declines

Gulf-wide landings of anchovies, sardines, and mackerels have declined by 30–50 % since the 1990s (FAO FishStatJ, 2024). Cambodia’s coastal catch peaked near 120,000 tonne per year in 2005 but fell to roughly 85,000 tonne per year by 2020, mirroring regional overfishing of shared stocks. Fishers increasingly travel farther offshore for smaller catches and lower-value species. These biological linkages make national recovery efforts ineffective unless neighbouring states adopt complementary measures.

5.3.1.3 Illegal, Unreported and Unregulated (IUU) Fishing

IUU activity remains pervasive and inherently transboundary. Cambodian artisanal vessels frequently cross into Thai and Vietnamese waters, while foreign trawlers operate illegally inside Cambodia’s EEZ. Weak Monitoring, Control and Surveillance (MCS) capacity, limited vessel registration, and fuel-subsidy distortions perpetuate excess effort. In 2022, authorities detained 11 foreign trawlers for illegal operations in Cambodian waters, while Thai enforcement seized 27 Cambodian vessels for boundary incursions. The impacts are ecological and economic: trawling damages >20 % of Kampot seagrass beds, destroying nursery habitats; IUU undermines legal operators, distorts markets, and erodes government revenue.

5.3.1.4 Ecosystem and Habitat Degradation

Chronic trawling pressure, mangrove clearance, and near-shore pollution from urban and industrial discharges have degraded coral, seagrass, and estuarine habitats vital for fish recruitment. Loss of these habitats amplifies the effects of overfishing by reducing spawning biomass and juvenile survival. Combined with rising sea temperature and eutrophication, these pressures threaten regional ecosystem stability and biodiversity.

5.3.1.5 Socio-Economic and Governance Risks

The ecological crisis translates directly into socio-economic vulnerability. Marine and inland fisheries together supply 60–70% of Cambodia's animal protein intake, and the sector employs hundreds of thousands across the value chain (FiA, 2025). Continued stock decline jeopardizes food security, income, and employment in coastal provinces such as Koh Kong and Preah Sihanouk, where dependence on fishing is highest. High levels of capacity-enhancing subsidies and an unregistered small-scale fleet sustain over-capacity and discourage compliance. Weak data sharing and incompatible legal frameworks among Gulf states further limit joint enforcement and stock recovery.

5.3.2 Climate-change impacts and interactions with other TDA components

5.3.2.1 Climate-Change Impacts

Climate change acts as a stress multiplier on already pressured fisheries. Warming seas and marine heatwaves reinforce "fishing down the food web", favouring smaller, lower-trophic species (FAO, 2022; Pauly & Cheung, 2018). Upstream dams and altered flood pulses disrupt migration and recruitment that sustain 70–75% of national catch from inland systems (Arias et al., 2019; Fiorella et al., 2019). Coastal land reclamation, mangrove loss and pollution further weaken nursery habitats (Lo et al., 2018; Girkin et al., 2022).

Sea-level rise along Cambodia's coast is projected at about 0.21 m by 2050 and 0.69 m by 2100, with a 1 m scenario potentially inundating ~25,000 ha of low-lying land in Koh Kong and increasing saltwater intrusion into aquifers and farmland (ICON-Institut GmbH, 2021; Government of Cambodia, 2025).

For marine capture fisheries, regional models suggest a 5–15% decline in maximum catch potential by mid-century and 10–30% by 2100 (Cheung et al., 2010; Barange et al., 2018). For Cambodia this implies a 5–10% drop in coastal catch by 2050 and up to 20–25% by 2100 if current pressures continue (FiA, 2024). Mangrove- and seagrass-associated shrimps, crabs and demersal fish are especially vulnerable as their habitats face inundation, erosion and salinity shifts (MoE, 2023; Government of Cambodia, 2025).

Sea-level rise and lower dry-season flows will also intensify saltwater intrusion, affecting aquaculture. Freshwater farms (tilapia, carp) risk salinity stress, while brackish farms (shrimp, mud crab) may expand but become more disease-prone (ICON-Institut GmbH, 2021; FAO, 2024). Higher pumping and treatment costs are likely where non-saline groundwater declines. Without adaptation—salinity-tolerant species, better pond design, stronger biosecurity—yields in poorly managed systems could fall by several percent by mid-century (FAO, 2024).

Climate impacts in coastal zones will spill inland as fishers and workers shift effort toward Tonle Sap and the Mekong floodplains, adding pressure to already stressed inland stocks (FiA, 2024; FAO, 2024). Salinisation and job loss will erode livelihood diversity and raise poverty. Given that fish provide over 60% of animal protein intake, even modest production declines could worsen food and nutrition security, especially for low-income households (FAO, 2024; ICON-Institut GmbH, 2021).

5.3.2.2 Marine-pollution impacts

Marine pollution is a pervasive, transboundary stressor that interacts with climate change. Key sources are untreated domestic wastewater, industrial effluent, agricultural runoff, marine litter and ship-based discharges. Materials entering the Gulf of Thailand are transported to Thai and Vietnamese waters.

In Sihanoukville, over 80% of municipal wastewater is discharged untreated. Monitoring in 2022 recorded total nitrogen ~0.6 mg/L (vs. ASEAN guideline 0.3 mg/L) and total phosphorus 0.07–0.09 mg/L in Kampot Estuary, driving eutrophication, harmful algal blooms, hypoxia and fish kills. Effluents from the Sihanoukville SEZ contain high BOD and trace metals (e.g. cadmium, mercury), which accumulate in sediments and biota, threatening food safety and export prospects.

Agricultural runoff from the Mekong Basin adds fertilizers, pesticides and sediments, increasing turbidity and smothering coral and seagrass, while reinforcing eutrophication already driven by urban waste.

Cambodia generates around 0.27 million tonnes of mismanaged plastic annually (World Bank, 2021). Beach surveys in Sihanoukville and Kampot record 4,000–6,000 plastic items per km of shoreline, 20–30% from fishing gear. Ghost nets and traps continue to catch fish and turtles and damage seagrass and coral, often drifting into neighbouring EEZs.

Shipping through Sihanoukville Autonomous Port (over 5 million tonnes of cargo in 2022) increases risks of oil and chemical spills. The 2019 Koh Rong spill (~50 tonnes of oil) reached Vietnamese waters within 72 hours, illustrating strong hydrodynamic connectivity and shared vulnerability.

5.3.2.3 Socio-economic impacts and interactions

Rapid growth in ports, SEZs, tourism and coastal cities has created jobs but outpaced environmental safeguards. Industrial and urban expansion in Sihanoukville has increased wastewater and solid-waste loads beyond treatment capacity; unzoned tourism development and shrimp farms continue to convert mangroves and destabilize shorelines. Upstream agricultural intensification adds fertilizers and pesticides to coastal waters.

Population growth and in-migration have produced large informal settlements with limited sanitation. Over 40% of coastal households still discharge wastewater directly to the environment (MoE, 2022). Poor households rely heavily on small-scale fishing, low-input aquaculture and charcoal production from mangroves—activities vital for survival but cumulatively degrading ecosystems. Limited capital and technology constrain uptake of cleaner practices.

These dynamics reflect a broader “poverty–environment trap” across the Gulf of Thailand: short-term growth and coping strategies undermine the natural capital that supports livelihoods, while pollution and climate impacts cross borders and link Cambodia’s coastal management challenges with those of Thailand and Viet Nam.

5.3.3 Current governance to address fisheries problems

5.3.3.1 Management and conservation efforts

Over the past two decades, Cambodia has undertaken major fisheries reforms, gradually moving from centralized control toward community-based and ecosystem-based management with stronger focus on co-management, stock conservation and IUU control.

a) Inland fisheries governance

Abolition of commercial fishing lots in 2000 and 2012 transferred access rights to Community Fisheries (CFis) across the Tonle Sap, Mekong and Bassac floodplains, improving equity and local stewardship. Studies of community fish refuges show that well-governed CFis maintain higher biomass and species diversity than nearby open-access areas (Fiorella et al., 2019). However, many CFis still face capacity, financing and technical gaps that limit effective enforcement and long-term sustainability.

b) Marine and coastal management.

The Fisheries Law (2006), National Plan of Control and Inspection for Marine Fisheries 2020–2024, and the National Plan of Action to Prevent, Deter and Eliminate IUU Fishing provide the core framework for licensing, vessel control and enforcement (FiA/MAFF, 2020). Marine Fisheries Management Areas around Koh Rong, Kep and parts of Koh Kong protect key mangrove, coral and seagrass habitats and anchor Cambodia's emerging network of marine spatial measures (FiA, 2021).

c) Fleet characteristics, effort control and enforcement

The 2018 census shows a predominantly small-scale, informal fleet: 97% of marine vessels are unregistered and nearly 90% have engines <50 HP (FiA, 2024). Trawls account for 55–60% of marine landings, with 35–45% of trawl catch now "trash fish"—juveniles and low-value species for fishmeal—indicating biological overexploitation and economic inefficiency (FiA, 2023; SEAFDEC, 2018; Pauly & Zeller, 2020). Although trawl limits, seasonal closures and gear rules exist, compliance is weakest in inshore waters where illegal push-nets and fine-mesh gears persist.

d) Institutional capacity and incentives

The 2020–2024 control plan has improved the framework for Monitoring, Control and Surveillance, supported by CAPFISH and GEF/UNDP projects (MCS training, VMS pilots, data digitization). Yet enforcement is constrained by limited budgets, patrol assets and fragmented mandates, and community surveillance groups still lack strong sanctioning powers. Capacity-enhancing subsidies have declined since 2003, but market drivers—fishmeal demand, port upgrades, access to credit—continue to support high fishing capacity. Shifting incentives toward value-added products, reduced effort and diversified livelihoods remains essential for a fully effective, climate-resilient governance system.

5.3.3.2 Regional cooperation

Given the shared nature of fish stocks, pollution and fishing effort in the Gulf of Thailand and South China Sea, Cambodia's fisheries governance is increasingly shaped by regional and sub-regional frameworks. Cambodia participates in many platforms that promote shared data and responsible fishing, although enforcement and practical harmonization are still limited.

a) Participation in regional and sub-regional mechanisms

Cambodia is an active member of SEAFDEC initiatives, including Joint Gulf of Thailand Trawl Surveys, stock-assessment working groups and implementation of the Regional Guidelines for Responsible Fisheries (SEAFDEC, 2018; 2019). These provide comparable CPUE and biomass data, inform resource-status assessments and promote BRDs and trawl-zoning schemes. Cambodia is also party to key ASEAN and FAO instruments—the ASEAN IUU Guidelines, Port State Measures Agreement and FAO Code of Conduct—and engages bilaterally with Thailand and Viet Nam on maritime boundaries, joint patrols and data exchange.

b) Regional and international projects

Through the FAO/GEF BOBLME project, the Gulf of Thailand Sub-Regional Framework and EU-funded CAPFISH programmes, Cambodia has strengthened MCS and community enforcement, modernised FIMS and stock-assessment capacity, and upgraded post-harvest and value-chain systems (FAO, 2015; FiA, 2021). However, cooperation on effort limitation, gear standardization and IUU blacklist sharing remains limited. Foreign industrial fleets continue to exert substantial pressure within Cambodia's EEZ, reflected in high PPR values and multinational catch footprints (Sea Around Us, 2024), and no joint harvest-control rules or quota systems are yet operational.

c) Regional environmental and coastal cooperation

Cambodia participates in COBSEA on marine litter, pollution control and habitat protection, and in ASEAN initiatives on biodiversity, disaster risk reduction and coastal management. Through PEMSEA, Cambodia has prepared State of the Coasts reports and piloted Integrated Coastal Management in Sihanoukville, providing models for ecosystem-based and blue-economy planning.

d) Bilateral and global engagement

Cambodia cooperates with Viet Nam and Thailand on fisheries and pollution control, including periodic joint patrols against IUU fishing, and aligns national policy with SDG 14 and the Kunming–Montreal Global Biodiversity Framework. These commitments are reflected in the Blue Economy Roadmap (2024–2030) and NDC 3.0 coastal-adaptation components (Government of Cambodia, 2025).

e) Challenges and opportunities

Regional mechanisms offer strong platforms for joint monitoring and standard setting, but Cambodia's engagement is constrained by limited analytical capacity, scarce and project-based financing, and fragmented coordination among fisheries, environment and maritime-security agencies. Strengthening inter-agency cooperation, investing in stock-assessment and modelling skills, and securing more predictable funding would allow Cambodia to better leverage regional frameworks to address transboundary fisheries, pollution and climate risks.

5.3.4 Recommended priority actions (including regional cooperation)

a) Rebuilding over-exploited stocks and reducing fishing pressure

The most urgent priority is to rebuild demersal and small-pelagic stocks through firm effort controls paired with habitat protection. This starts with completing registration and licensing of all marine vessels to establish a verifiable fleet baseline. Effort should then be capped and progressively reduced for trawl and purse-seine fleets, with strict protection of inshore waters (<20 m). Trawl-free zones and seasonal closures should be expanded and timed to spawning and recruitment periods, while gear rules require selectivity measures (e.g., BRDs and minimum mesh sizes) to reduce juvenile catch and bycatch. Incentives should also support a shift away from "trash-fish"–based fishmeal toward higher-value products for human consumption.

b) Ecosystem-based management and climate adaptation

Fisheries sustainability depends on resilient coastal ecosystems and planning that reflects climate and hydrologic change. Management should restore and conserve mangroves, seagrass, and coral reefs as nurseries and blue-carbon buffers, and integrate climate projections and basin-hydrology models into fisheries rules and aquaculture zoning. Nearshore water quality should be improved through stronger control of wastewater, agricultural runoff, and plastic leakage. Monitoring should be strengthened through regular trawl/acoustic surveys, standardized sampling, and community logbooks to improve ecological evidence and local accountability.

c) Strengthening governance, compliance and socio-economic resilience

Reform is needed to reduce effort while safeguarding fishing communities. Monitoring, Control and Surveillance (MCS) should be scaled through joint patrols, VMS/AIS coverage for industrial vessels, and formalized community surveillance. Catch-and-effort management requires modernizing FIMS and ensuring consistent reporting across provinces. Subsidies should be redirected away from capacity-enhancing support toward alternative livelihoods, safety-at-sea, post-harvest value addition, and compliance training. Co-management should be strengthened by clarifying CFi rights, improving benefit-sharing, and expanding local enforcement authority, with stronger gender and social inclusion in decision-making and in aquaculture and processing roles.

d) Regional and transboundary cooperation

Shared stocks and pressures require deeper collaboration through SEAFDEC, ASEAN, and SCS-SAP frameworks. Priorities include joint stock assessments, reference points, and catch-potential modelling for shared species; harmonized gear and mesh standards with Thailand and Viet Nam; and a shared IUU information system with coordinated MCS operations. Cambodia should also explore joint effort-reduction or vessel buy-back schemes, especially for Gulf trawl fleets, and strengthen regional ecosystem and climate-science collaboration, including vulnerability mapping. Linked MPAs, mangrove corridors, and pollution-control zones should be promoted to improve Gulf-wide connectivity and resilience.

5.4 Methodology and Analysis

This assessment follows the indicator-based TDA approach, combining harmonized long-term datasets, provincial statistics, ecological indicators, and targeted literature to evaluate pressures, ecosystem condition, and fleet dynamics in Cambodia's marine fisheries. Biophysical, economic, and institutional evidence is integrated to inform transboundary diagnostic findings and SAP prioritization.

5.4.1 Data Sources and Integration

The analysis draws on national and regional datasets, including FAO FishStatJ (1950–2022) for capture and aquaculture trends; FiA statistics (2012–2024), including the 2018 Marine Vessel Census, for provincial production, fleets, licensing and aquaculture; Sea Around Us (1950–2019) for reconstructed catches and ecosystem indicators (e.g., MTI, FiB, PPR) and subsidy estimates; and SEAFDEC trawl/resource surveys (1966–2019), complemented by recent MaFReDI information, for demersal CPUE/biomass proxies. Peer-reviewed studies on reef condition and biodiversity provide additional context. Quantitative series were cross-checked with FiA technical experts (2024–2025) and reviewed against key policy instruments (e.g., Fisheries Law, FiA strategic framework). Full metadata and indicator methods are provided in the Annex.

5.4.2 Indicator Framework

Indicators were selected for relevance, time-series continuity, and alignment with the SCS–SAP TDA template, covering: (i) production and value (national/provincial catch and aquaculture trends), (ii) ecosystem condition (MTI, FiB, PPR, stock-status plots, CPUE as biomass proxy), (iii) fleet and gear pressure (vessel numbers/power, registration, trawl/purse-seine shares, small-scale contributions), and (iv) economic drivers (capacity-enhancing subsidies and subsidy-to-value ratios). Definitions and transformations are documented in the Annex.

5.4.3 Spatial and Temporal Assessment

Trends are analysed across the 1950s–2020s to identify phases of expansion, depletion, partial recovery, and recent intensification. Spatial profiling focuses on Koh Kong, Preah Sihanouk, Kampot, and Kep, examining production concentration, fleet distribution, aquaculture hotspots, and overlap of fishing pressure with mangroves, seagrass, and coral ecosystems. GIS layers from FiA/SAUP support hotspot mapping of effort and ecological pressure.

5.4.4 Ecosystem–Economic Linkages

Ecological and economic signals are linked by comparing MTI/FiB/PPR and stock-status patterns with production and value trends, using CPUE to infer biomass depletion and examining how subsidies and fleet structure reinforce overcapacity. Results indicate rising production/value despite declining underlying ecosystem productivity, consistent with “fishing through the food web.”

5.4.5 Data Gaps and Limitations

Key gaps include incomplete long-term CPUE/biomass series, limited separation of small-scale versus industrial activity, under-reporting of unregistered vessels and IUU catches, sparse species-level aquaculture data, and limited information on foreign-fleet interactions. These constraints reinforce the need to strengthen FIMS, expand stock assessments, and improve regional data-sharing through SEAFDEC and the SCS–SAP framework.

Glossary

Term	Definition
Aquaculture	Farming of aquatic organisms (fish, crustaceans, molluscs, aquatic plants) in freshwater, brackishwater, or marine environments.
Artisanal / small-scale fisheries	Fishing using small vessels and simple gears, often nearshore, supporting household income and local food supply.
Bottom trawling	Towing a net along the seabed; typically associated with high habitat disturbance and bycatch risk.
BRD (Bycatch Reduction Device)	Device fitted to trawl nets to reduce unwanted catch (bycatch), including juveniles and non-target species.
Catch	Amount of fish and other aquatic organisms harvested (commonly measured in tonnes/year).
Catch-and-effort data	Data on quantities caught and fishing activity (e.g., trips, days, gear), used to track trends and guide management.
CPUE (Catch Per Unit Effort)	Catch per unit of effort (e.g., kg/hour); often used as a proxy for abundance/biomass when standardized.
Demersal species	Fish that live and feed near the seabed (common in multispecies trawl fisheries).
EEZ (Exclusive Economic Zone)	Sea area where a coastal state has sovereign rights over marine resources.
Effort reduction	Measures that decrease fishing pressure (limits on vessels/gear/days, buy-back schemes, closures).
Fish biomass	Total weight of fish in a population/stock; estimated from surveys or standardized CPUE when biomass data are limited.
Fishing down the food web	Shift toward harvesting lower-trophic species as larger predators decline, reflected in declining trophic indicators.
FiB (Fishing-in-Balance Index)	Indicator comparing catch changes with trophic structure and ecosystem productivity; instability can signal ecological limits.
Fleet (fishing fleet)	The set of fishing vessels operating in an area, often grouped by size and engine power.
Gear selectivity	Degree to which gear targets intended species/sizes while avoiding juveniles and non-target species (mesh sizes, BRDs, etc.).
Habitat / nursery grounds	Habitats (mangroves, seagrass, reefs, estuaries) supporting spawning, juvenile growth, and recruitment into fisheries.
IUU fishing	Illegal, Unreported and Unregulated fishing that undermines sustainability and compliance, often transboundary.
Landing value	Monetary value of harvested fish at landing.
MCS (Monitoring, Control and Surveillance)	Compliance system using patrols, inspections, licensing, VMS/AIS and community surveillance.
MFMA (Marine Fisheries Management Area)	Spatial fisheries management area used to manage fishing pressure and protect habitats through zoning/rules.
MTI (Marine Trophic Index)	Average trophic level of catches; declining MTI suggests loss of higher-trophic predators.
Over-exploited stock	Stock harvested above sustainable levels, reducing long-term yields and recovery potential.
PPR (Primary Production Required)	Ocean primary productivity needed to support catches; sustained high values indicate pressure near/above ecosystem capacity.
Purse seine	Net encircling schooling fish and drawn closed; often targets small pelagics.
Registration and licensing	Administrative processes that record vessels and authorize fishing; low compliance undermines effort control.
Seasonal closure	Temporary restriction to protect spawning/recruitment periods and reduce pressure on depleted stocks.

Shared stocks	Fish populations that move across national boundaries, requiring cooperation among countries.
Stock-status plots	Indicators classifying stocks (e.g., developing, exploited, over-exploited, collapsed) to show long-term trajectories.
Subsidies (capacity-enhancing)	Financial support that increases fishing capacity and can worsen overfishing without effective controls.
Trawl-free zone / inshore protection	Spatial restriction limiting/prohibiting trawling (often shallow waters) to protect habitats and reduce juvenile/bycatch.
Trash fish	Low-value mixed catch (often juveniles/small species) commonly used for fishmeal; high shares can signal growth overfishing.
VMS/AIS	Vessel tracking systems used for safety and compliance monitoring, often prioritized for industrial fleets.

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Annex 5

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List of Acronyms

ACIAR	Australian Centre for International Agricultural Research
AIS	Automatic Identification System
BRD	Bycatch Reduction Device
BOBLME	Bay of Bengal Large Marine Ecosystem (project)
CAPFISH	EU–Cambodia Programme for Sustainable and Inclusive Growth in the Fisheries Sector
CFi	Community Fisheries
CFR	Community Fish Refuge
COBSEA	Coordinating Body on the Seas of East Asia
CPUE	Catch Per Unit Effort
EEZ	Exclusive Economic Zone
FAO	Food and Agriculture Organization of the United Nations
FiA	Fisheries Administration (Cambodia)
FiB	Fishing-in-Balance Index
FIMS	Fisheries Information Management System (Cambodia)
GEF	Global Environment Facility
GDP	Gross Domestic Product
HP	Horsepower
ICM	Integrated Coastal Management
ICON	ICON-Institut (consulting firm for climate/ICM studies)
IFA	Inshore Fishing Area
IUU	Illegal, Unreported and Unregulated (fishing)
km²	Square kilometre
LME	Large Marine Ecosystem
MAFF	Ministry of Agriculture, Forestry and Fisheries (Cambodia)
MaFReDI	Marine Fisheries Research and Development Institute (FiA)

MCS	Monitoring, Control and Surveillance
MoE	Ministry of Environment (Cambodia)
MPA	Marine Protected Area
MTI	Marine Trophic Index
NDC	Nationally Determined Contribution (under the Paris Agreement)
PEMSEA	Partnerships in Environmental Management for the Seas of East Asia
PPR	Primary Production Required
PSMA	Port State Measures Agreement (FAO)
R&D	Research and Development
SAU / SAUP	Sea Around Us (Project)
SAP	Strategic Action Programme
SDG	Sustainable Development Goal
SEAFDEC	Southeast Asian Fisheries Development Center
SOFIA	The State of World Fisheries and Aquaculture (FAO flagship report)
TDA	Transboundary Diagnostic Analysis
TED	Turtle Excluder Device
UNDP	United Nations Development Programme
USD	United States Dollar
VMS	Vessel Monitoring System

Annex 5-1 Data Sources

Annex Table 5-1 National Data

Source	Coverage	Variables	Notes
Fisheries Administration (FiA), MAFF	2012–2024	Marine capture production (by province, gear); aquaculture output; vessel registration; licensing; MCS operations	Core national dataset; annual time-series used for production and spatial analysis
FiA Marine Fishing Vessel Census (2018)	National coastal provinces	Vessel numbers, size class, engine power, registration status	Main fleet-structure baseline
FiA Strategic Planning Framework 2025–2034	Policy	Governance, management priorities	Used for institutional interpretation
National Fisheries Law (2006)	Policy	Legal framework	Used for governance context

Annex Table 5-2 Regional & International Data

Source	Variables	Notes
FAO FishStatJ (1950–2022)	Capture production, aquaculture production, landed value	Basis for long-term national trend analysis
Sea Around Us (SAUP) (1950–2019)	Reconstructed catch; stock-status plots; MTI, FiB, PPR indices; subsidy estimates	Used for ecological and economic indicators

SEAFDEC Trawl & Resource Surveys (1966–2019)	Demersal CPUE, biomass proxies, species assemblages	Key baseline for biomass depletion
MaFReDI (2023)	Coastal CPUE monitoring	Complements SEAFDEC trend
Peer-reviewed literature	Ecosystem condition (reefs, seagrass, biodiversity)	Used for contextual validation

Annex 5-2 Indicator Metadata Tables

Production Indicators

Cambodia's fisheries comprise inland, marine and aquaculture components, together contributing significantly to food security and rural livelihoods. Inland systems dominate national catch due to the Tonle Sap–Mekong flood-pulse system, while marine production—though smaller—remains central to coastal economies. Long-term expansion of motorized fleets, increased fishing effort and gear modernization have contributed to higher landings but also heightened ecological pressures. Aquaculture has emerged as a major contributor to national production, although marine and brackish components remain modest and concentrated geographically.

Aquaculture has grown rapidly since the early 2000s, dominated by freshwater pond and cage culture (≈95% of output). Marine and brackish aquaculture remain limited but strategic, focusing on groupers, seabass and shellfish in Koh Kong, Preah Sihanouk and Kampot. Coastal aquaculture has recently contracted due to land constraints, disease outbreaks, salinity change and rising operational costs. Climate stress (salinity intrusion, higher water temperature) and weak biosecurity further affect productivity. Expansion potential exists but requires improved planning, hatchery capacity and environmental safeguards.

Annex Table 5-3 Production Indicators

Indicator	Definition	Units	Data Source	Temporal Coverage
Total capture production	Combined inland + marine capture	tonnes/year	FAO; FiA	1950–2024
Marine capture (by province)	Marine landings by coastal province	tonnes/year	FiA	2012–2024
Aquaculture production	Freshwater, brackish, marine farmed output	tonnes/year	FAO; FiA	1976–2024

Annex 5-3 Explanatory note for marine catches by gear type

Cambodia's marine fisheries show a long-term industrialization trajectory. Gear composition indicates a transition from primarily small-scale and artisanal operations to a more mechanized, trawl-dominated sector after the mid-1980s, followed by moderate diversification with small-scale gears regaining share after 2005. The trawl share averaged 55–60% of marine catch, while purse seines averaged 30–35%. This gear composition aligns with broader regional trends in the Gulf of Thailand, where bottom-trawl and purse-seine fleets expanded rapidly and later plateaued due to overexploitation, fuel costs, and habitat degradation.

Trawl fisheries (bottom trawl & shrimp trawl): Trawling is the dominant gear in Cambodia's marine sector. From small beginnings in the 1960s (<1,000 tonnes), trawl catch expanded with mechanization to ~71,900 tonnes (1970), surged through the 1980s–1990s to 153,700 t (1990), and peaked at ~181,000 tonnes (2002). Since the mid-2000s it has plateaued around 118,000–138,000 tonnes, consistent with capacity saturation and tighter licensing/zoning. Trawl dominance coincided with rapid sediment resuspension and benthic degradation in coastal waters, particularly in Kampot and Koh Kong, with ecological implications for demersal stock recovery.

Purse-seine fisheries: Purse seining emerged in the mid-1960s (~10,400 t) and grew rapidly with synthetic nets and motors, climbing to ~37,100 t (early 1970s) and peaking near 191,500 t (2000) as small pelagics were heavily targeted. Since 2005, catches have moderated to ~53,000–67,000 t a year. This trend reflects both stock limitation of small pelagics and tighter FiA restrictions on encircling nets within 20 m depth zones.

Small-scale gears: Subsistence and artisanal fishing gears (gillnets, traps, handlines) rose from ~11,000–14,000 tonnes in the 1960s–1970s to ~47,000 tonnes in the mid-1980s, then stabilized around 15,000–18,000 t after 2000—about 10% of marine landings—remaining crucial for food security in provinces such as Kep and Kampot. Although quantitatively smaller, small-scale gears underpin food security and coastal livelihoods. Their persistence signals the resilience of artisanal sectors under industrial pressure.

Other Gears (longlines, handlines, traps, and unknown): Minor and variable, these gears collectively contributed less than 1% of national marine landings (e.g., 1,986 tonnes in 2019). Their presence reflects residual multi-gear operations in estuarine and reef zones, often tied to seasonal or subsistence activity.

Annex Table 5-4 Marine Catches by Gear Type in Cambodian Waters (tonne)

Year	Trawl	Purse seine	Small-scale gears	Others
1960			15,900	1
1961	964		26,237	2
1962	996		24,180	1
1963	1,034		17,786	2
1964	1,089		18,096	3
1965	26,479	10,448	11,609	0
1966	35,321	14,883	11,926	0
1967	43,991	18,814	12,246	0
1968	51,291	20,873	12,570	1
1969	58,958	23,206	12,897	3
1970	71,875	33,463	13,227	6
1971	80,486	33,790	13,561	4
1972	87,707	37,123	13,898	7
1973	74,207	35,186	14,239	7
1974	71,379	35,891	14,582	6
1975	69,967	37,889	1,493	7
1976	57,369	32,439	1,479	10

1977	67,315	43,224	1,465	7
1978	69,154	44,822	1,451	0
1979	64,043	43,410	1,435	0
1980	59,144	38,878	11,888	6
1981	74,097	53,839	16,622	35
1982	82,655	57,700	23,062	111
1983	88,293	71,940	30,317	190
1984	87,215	68,106	38,579	89
1985	95,021	75,984	47,519	145
1986	107,724	81,110	47,775	236
1987	131,685	96,714	47,498	543
1988	126,418	99,052	47,390	355
1989	133,176	101,253	46,655	460
1990	153,674	108,375	45,622	523
1991	149,627	110,901	44,231	600
1992	156,208	132,184	42,205	968
1993	156,035	128,059	41,608	778
1994	153,105	145,527	40,190	938
1995	158,694	148,784	38,439	932
1996	158,521	149,475	36,372	714
1997	156,602	148,708	33,800	448
1998	156,924	150,390	42,609	575
1999	172,586	183,898	30,423	1,305
2000	174,434	191,546	30,148	1,448
2001	177,634	173,241	28,500	1,434
2002	181,024	177,998	27,119	1,130
2003	180,536	168,557	24,992	1,560
2004	175,633	163,826	27,258	1,611
2005	176,611	161,134	24,637	1,930
2006	158,331	139,535	22,450	1,749
2007	152,662	134,268	19,854	1,875
2008	96,655	39,517	26,085	2,324
2009	104,295	45,002	15,442	1,434
2010	92,606	57,656	15,677	1,612
2011	114,197	66,367	15,876	1,744
2012	119,516	70,761	16,526	1,754
2013	111,572	56,554	16,747	1,810
2014	125,749	62,512	17,111	1,674
2015	119,318	58,021	17,397	1,694
2016	118,096	53,239	17,334	1,688
2017	118,362	53,555	17,607	1,714
2018	138,010	67,097	17,630	1,972

2019	128,483	63,634	17,644	1,986

Source: Sea Around Us (SAU), 2024. Catches by Gear in the waters of Cambodia

Annex Table 5-5 Aquaculture production & value (FAO).

Year	Aquaculture		Marine		Brackishwater		Freshwater	
	Tonnes - live weight	Value (USD 1000)	Tonnes - live weight	Value (USD 1000)	Tonnes - live weight	Value (USD 1000)	Tonnes - live weight	Value (USD 1000)
1976	4		0		0		4	
1977	11		0		0		11	
1978	25		0		0		25	
1979	53		0		0		53	
1980	106		0		0		106	
1981	240		0		0		240	
1982	464		0		0		464	
1983	934		0		0		934	
1984	1,610	2,543	0	0	0	0	1,610	2,543
1985	3,000	5,005	0	0	0	0	3,000	5,005
1986	2,200	3,933	0	0	0	0	2,200	3,933
1987	2,500	4,757	0	0	0	0	2,500	4,757
1988	4,600	9,356	0	0	0	0	4,600	9,356
1989	5,538	11,900	0	0	0	0	5,538	11,900
1990	6,400	13,943	0	0	0	0	6,400	13,943
1991	6,700	15,332	0	0	0	0	6,700	15,332
1992	8,550	18,869	0	0	0	0	8,550	18,869
1993	7,900	19,758	0	0	500	2,860	7,400	16,898
1994	8,200	20,694	0	0	560	3,248	7,640	17,446
1995	9,511	23,530	0	0	731	4,240	8,780	19,291
1996	9,600	23,252	0	0	600	3,480	9,000	19,772
1997	11,800	25,957	0	0	266	1,569	11,534	24,387
1998	14,100	28,847	0	0	1,515	2,764	12,585	26,083
1999	15,000	29,383	0	0	712	1,197	14,288	28,186
2000	14,430	28,275	0	0	428	656	14,002	27,618
2001	17,500	28,836	3,500	875	537	1,399	13,463	26,562
2002	18,250	27,510	3,650	913	467	803	14,133	25,795
2003	26,300	35,726	7,800	1,950	614	1,131	17,886	32,645
2004	37,515	40,935	16,840	4,210	775	1,285	19,900	35,440
2005	44,000	49,947	18,000	4,500	1,000	1,707	25,000	43,740
2006	41,010	62,241	6,810	1,703	1,400	1,968	32,800	58,570
2007	35,260	62,767	0	0	1,360	2,027	33,900	60,740
2008	40,000	70,470	1,560	3,815	90	450	38,350	66,205

2009	50,000	91,548	1,940	4,320	95	475	47,965	86,753
2010 (a)	60,000	112,570	2,120	5,060	100	500	57,780	107,010
2011	72,000	136,850	2,500	6,000	120	600	69,380	130,250
2012	74,000	144,530	2,810	6,380	160	800	71,030	137,350
2013	90,000	174,540	3,250	7,100	160	800	86,590	166,640
2014	120,055	226,143	4,350	9,600	170	850	115,535	215,693
2015	145,000	270,975	3,400	8,140	170	850	141,430	261,985
2016	172,500	321,303	9,744	20,476	1,053	5,265	161,703	295,562
2017	207,500	616,770	10,150	21,540	1,070	5,350	196,280	589,880
2018	254,050	754,210	12,160	24,670	1,280	6,400	240,610	723,140
2019	307,408	924,939	13,988	27,824	1,340	6,700	292,080	890,415
2020	400,400	1,209,505	18,000	34,720	1,720	8,600	380,680	1,166,185
2021	348,350	1,051,925	15,670	30,220	1,490	7,450	331,190	1,014,255
2022	330,600	998,865	14,890	28,810	1,400	7,000	314,310	963,055

Source: *FAO, 2024. FishStatJ.*

B2. Ecological Indicators

Ecosystem indicators show a persistent decline in trophic integrity and biomass. MTI trends reflect the loss of larger predatory species, while FiB signals decades of effort expansion compensated by exploitation of lower-trophic species. PPR values exceeding 2.0 during peak years indicate ecological footprints surpassing carrying capacity. CPUE declines (>80% since the 1960s) suggest substantial demersal biomass depletion. Habitat degradation—mangrove loss, seagrass decline, turbidity—further constrains recovery potential. Together, these indicators describe a system under high stress and low resilience.

Annex Table 5-6 Ecological Indicators

Indicator	Definition	Units	Method Source
Marine Trophic Index (MTI)	Mean trophic level of catch	Unitless	SAUP algorithm
Fishing-in-Balance Index (FiB)	Expansion/compensation index	Unitless	Pauly & Christensen (1995)
Primary Production Required (PPR)	PP needed to sustain fisheries	Fraction of PP	SAUP
Stock-status plots	Composition of developing/exploited/overfished/collapsed stocks	%	SAUP
CPUE (demersal)	Trawl catch per unit effort	kg/hour	SEAFDEC; MaFReDI

Annex 5-4 Explanatory note for Stock-status plots

Cambodia's marine fisheries have shifted from developing to heavily exploited conditions. The shift from green (Exploited) to orange/red (Over-exploited/Collapsed) means that over time, the Cambodian catch became increasingly dependent on unhealthy stocks. This is unsustainable and signals a fishery in crisis. The rise in the number of over-exploited and collapsed stocks confirms that the problem is not isolated. The entire marine ecosystem is under severe stress, with many distinct populations unable to sustain themselves. Based on the stock-status plots show in the graphs (Figure 5-4), the history of Cambodian fisheries can be divided into three major phases.

- **Phase 1 – Developing phase (1950s–early 1970s):** Most marine stocks were in the Developing category, meaning fishing pressure was light and potential was still largely untapped. Over 95% of total catch came from developing stocks, indicating abundant resources and low exploitation levels.
- **Phase 2 – Exploited phase (1970s–1980s):** During the 1970s, the proportion of Exploited stocks rose sharply—from less than 1% in the mid-1960s to nearly 19% by 1970 and stabilizing around 10–12% through the early 1980 and —showing that fishing effort had expanded rapidly and many populations were being harvested near their sustainable limits. This period marks the transition from a largely developing fishery to one operating at full capacity.
- **Phase 3 – Over-Exploitation and collapse phase (~1980s–onward):** After 1990s, Over-exploited and Collapsed categories increased sharply while Developing stocks nearly disappeared. The share of over-exploited catches grew to about 10–15% by 2010, and collapsed stocks accounted for 5–6% by the late 2010s. Count-based indicators show that more than half of assessed stocks were already collapsed by 2018–2019. Although most landings still come from exploited demersal and pelagic species, this concentration masks widespread depletion and low recovery potential.

Overall, the stock trajectory signals a shift from underutilization to chronic overfishing and ecosystem stress. The near absence of developing or rebuilding stocks points to limited recruitment and recovery, underscoring the need for rebuilding plans, habitat restoration, and stricter trawl and bycatch management to sustain Cambodia's marine fisheries.

Annex 5-5 Explanatory note for Marine Trophic Index (MTI) and FiB index

MTI and the FiB trends, the data from SAUP –indicate that Cambodia's marine fisheries are now operating under heavy pressure with limited capacity for recovery. Without stronger stock rebuilding, habitat protection, and effort reduction measures, the long-term sustainability of the fishery and its supporting ecosystem remains at significant risk.

The Marine Trophic Index (MTI) in Cambodian waters reflects a long-term shift from balanced to simplified marine ecosystems. Between 1950 and 1960, the MTI remained high at around 3.83, suggesting a healthy and mature food web dominated by top and mid-level predators, with limited fishing pressure. From the early 1960s to the early 1990s, however, the MTI steadily declined, reaching 3.47 by 1992, indicating progressive depletion of large predatory fish and an increasing focus on smaller, lower-trophic-level species. This trend represents a clear case of "fishing down the marine food web." From the 1990s onward, the MTI became more volatile but remained lower, generally fluctuating between 3.50 and 3.57, with a slight improvement after 2010. This instability suggests an ecosystem increasingly reliant on short-lived and lower-trophic species, such as small pelagics and invertebrates. The recent mild increase may be associated with management interventions, improved enforcement, and reduced illegal, unreported, and unregulated (IUU) fishing activity in Cambodian waters. Overall, the long-term MTI decline demonstrates a reduction in ecosystem complexity and resilience, making the marine system more vulnerable to climatic and anthropogenic stressors.

The Fishing-in-Balance (FiB) Index presents a complementary narrative. During the 1950s, FiB values were near zero, reflecting a fishery in equilibrium with the ecosystem. The index then rose rapidly from the 1960s to the early 2000s, peaking at 2.97 in 2002, even as MTI declined. This combination indicates "fishing through the food web," where total catches were maintained by expanding fishing effort and targeting smaller, lower-trophic species to compensate for the loss of higher predators. After 2008, the FiB index dropped sharply—down to 2.08 by 2010—and remained volatile thereafter. This decline signals that the expansion strategy had reached its ecological limit: the marine ecosystem could no longer sustain high catches, even from lower levels of the food chain.

Therefore, the data strongly indicates that the ecological health of Cambodian waters has **significantly declined** over the past 70 years. The marine ecosystem has been fundamentally altered by fishing pressure. The recent volatility in the indices, especially the sharp drop in FiB, is a red flag. It suggests that the current level of fishing effort may be unsustainable, and the long-term health of the fishery and the ecosystem it depends on is at risk without significant management interventions aimed at rebuilding fish stocks and restoring ecosystem balance.

Annex 5-6 Explanatory note for Number of marine fishing vessels

FiA conducted a marine fishing vessel census in 2018 to gather data on the characteristics of the fishing fleet. The census provides a foundational dataset used for various monitoring and management purposes, but specific statistics from the final report, such as the total number of vessels, are not immediately available in the provided search results. The census recorded 7,552 marine fishing vessels across its four coastal provinces, reflecting a predominantly small- to medium-scale fleet structure. The majority of vessels (about 53 %) were classified as small-scale (< 12 m), while 47% fell within the medium-scale range (12–24m). Only 10 vessels exceeded 24 m, highlighting the limited presence of large industrial craft in national waters. The census showed strong geographic concentration: Koh Kong accounted for 45 % of all vessels (3,396 units), followed by Preah Sihanouk (33 %, 2,523 units), Kampot (14 %, 1,039 units), and Kep (8 %, 594 units). Koh Kong's predominance reflects its extensive coastal area and long-standing trawl and gill-net fleets, while Preah Sihanouk's share corresponds to its role as Cambodia's principal marine landing hub and industrial port. Kampot and Kep, by contrast, remain more artisanal and seasonally active, focusing on crab, squid, and small-pelagic fisheries.

Fleet characteristics by size and power: Vessel classification by engine power confirms the small-scale character of the fleet: approximately 6,699 vessels (89 %) were under 50 HP, with only a small minority exceeding 90 HP. This pattern suggests limited offshore capability and strong dependence on coastal and inshore fishing grounds. The few higher-horsepower vessels (181–540 HP) are mainly trawlers and purse-seiners operating from Koh Kong and Preah Sihanouk.

Registration and management: Of the 7,552 vessels enumerated, 97% were non-registered, and only 3% held valid registration. This extremely low compliance rate underscores persistent governance challenges, including inadequate enforcement capacity, outdated vessel records, and the prevalence of informal operations. The predominance of unregistered craft complicates management of fishing effort and hinders the implementation of licensing and monitoring systems essential for sustainable fisheries management.

Indeed, the 2018 census provides the first comprehensive snapshot of Cambodia's marine fleet, revealing a sector dominated by small-engine, non-registered vessels clustered in Koh Kong and Preah Sihanouk. While this structure supports local livelihoods and employment, it also poses significant management and sustainability concerns. The combination of high vessel density, limited registration, and low engine power reinforces the need for targeted governance reforms, particularly vessel licensing, gear regulation, and enforcement coordination among coastal provinces.

Annex Table 5-7 Number of Marine Fishing Vessels: Large, Medium and Small Scale

Vessel Type (Ranking m)	Koh Kong	Preah Sihanouk	Kampot	Kep	Total
Large Scale (≥ 24 m)	10	0	0	0	10
Medium Scale (12 ≤ 24)	962	1,545	629	367	3,512
Small Scale (< 12 m)	2,424	978	410	227	4,030
Total	**3,396**	**2,523**	**1,039**	**594**	**7552**
Type of Engine Power (HP)	**Koh Kong**	**Preah Sihanouk**	**Kampot**	**Kep**	**Total**
< 50	2,967	2,115	1,028	589	6,699
51 – 90	157	110	7	7	279
91 – 180	179	257	4	0	440
181 – 270	57	26	0	0	83
271 – 540	36	15	0	0	51
Total	**3,396**	**2,523**	**1,039**	**594**	**7552**
Type of Engine Power (HP)	**Koh Kong**	**Preah Sihanouk**	**Kampot**	**Kep**	**Total**
< 50	2,967	2,115	1,028	589	6,699
51 – 90	157	110	7	7	279
91 – 180	179	257	4	0	440
181 – 270	57	26	0	0	83
271 – 540	36	15	0	0	51
Total	**3,396**	**2,523**	**1,039**	**594**	**7552**
Registration Status	**Koh Kong**	**Preah Sihanouk**	**Kampot**	**Kep**	**Total (%)**
Non-Registered	3,217	2,469	1,039	593	7,318 (79%)
Registered	191	41	2	0	234 (3%)
Total	**3,408**	**2,510**	**1,041**	**593**	**7,552**

Source: FiA, MAFF. Marine Fishing Vessel and Licensing Database.

Annex 5-7 Assessment methods (by indicator)

A. Production & Value Indicators

- **Trend detection:**
  - CAGR and decadal comparison
  - Baseline periods: 1960s, 1990s, 2010s
- **Normalization:**
  - Harmonised FAO & FiA series
- **Spatial breakdown:**
  - 4 coastal provinces
  - Marine share of national capture

B. Ecological Indicators

Marine Trophic Index (MTI)

- Computed from SAUP species–trophic-level data
- Interpreted as proxy for ecosystem complexity and predator loss

Fishing-in-Balance (FiB)

- FiB = log(Ct / (C_0 × TE^(TL_0–TLt)))
- Indicates “fishing through/exhausting the food web”

Primary Production Required (PPR)

- PPR = Σ (Catch × PPR coefficient)
- Interpreted as ecological footprint vs. carrying capacity

CPUE (Biomass Proxy)

- Standardized trawl-survey CPUE compared across decades
- Interpreted as index of demersal fishable biomass

Stock-Status Plots

- Categorization: developing / exploited / overexploited / collapsed
- Tracks long-term shift in stock health

C. Fleet, Gear & Economic Indicators

- **Fleet capacity:** number × engine class × registration share
- **Gear pressure:** trawl %; purse-seine %; small-scale contribution
- **Subsidy incentives:** capacity-enhancing vs. management-support ratio

D Cross-Linkage Analysis

Indicators were interpreted together to assess:

- ecological–economic decoupling
- habitat–fleet interactions
- transboundary footprint (foreign fleets in PPR patterns)
- combined climate–fishing pressures