NATIONAL REPORT OF CAMBODIA

on

Transboundary Diagnostic Analysis (TDA)

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

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List of Acronyms

3Rs	Reduce, Reuse, Recycle
A2I	Access to Information (Law on Access to Information)
ADB	Asian Development Bank
AF	Adaptation Fund
AMR	Antimicrobial Resistance
ASEAN	Association of Southeast Asian Nations
AWT	Advanced Wastewater Treatment
BD	Biodiversity
BOD	Biochemical Oxygen Demand
BRD	Bycatch Reduction Device
CAA	Climate Adaptation Action
CBET	Community-Based Ecotourism
CCA	Causal Chain Analysis / Climate Change Adaptation (context-dependent)
CCDR	Climate and Development Report (World Bank)
CCCSP	Cambodia Climate Change Strategic Plan
CDRI	Cambodia Development Resource Institute
CF	Community Fishery
CFi	Community Fisheries Committee
CFU	Colony Forming Units
Chl-a	Chlorophyll-a
COD	Chemical Oxygen Demand
CP / CPUE	Catch-per-Unit Effort
CPA	Community Protected Area
CSO	Civil Society Organisation
DA	Disaster Assessment
DEM	Digital Elevation Model
DSW	Domestic Solid Waste
ECA	Environmental Conservation Area
EIA	Environmental Impact Assessment
ENSO	El Niño–Southern Oscillation
EPA	Environmental Protection Area / Environmental Protection Agency (contextual)
ESAC	Exposure–Sensitivity–Adaptive Capacity (risk model)
EWS	Early Warning System
FAO	Food and Agriculture Organization of the United Nations
FC	Fecal Coliform
FiA	Fisheries Administration (MAFF)
FiB	Fishing-in-Balance Index
FMU	Fisheries Management Unit
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographic Information System
GoC	Government of Cambodia

GoT	Gulf of Thailand
GPS	Global Positioning System
HABs	Harmful Algal Blooms
HDI / SHDI / IHDI	Human Development Index / Subnational HDI / Inequality-adjusted HDI
HF	Human Footprint Index
ICZM	Integrated Coastal Zone Management
IDPoor	Identification of Poor Households Programme
IFI	International Financial Institution
IMF	International Monetary Fund
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resources Management
LME	Large Marine Ecosystem
M&A	Monitoring & Assessment
MAFF	Ministry of Agriculture, Forestry and Fisheries
MCFA	Marine Capture Fisheries Administration
MDS	Marine Debris Survey
MEAs	Multilateral Environmental Agreements
MFRI	Marine Fisheries Research Institute
MFMA	Marine Fisheries Management Area
MMS	Marine Monitoring Stations
MoC	Ministry of Commerce
MoE	Ministry of Environment
MoH	Ministry of Health
MoI	Ministry of Interior
MoLMUPC	Ministry of Land Management, Urban Planning and Construction
MoP	Ministry of Planning
MoT	Ministry of Tourism
MPA	Marine Protected Area
MRV	Monitoring, Reporting and Verification
MSP	Marine Spatial Planning
MTI	Mean Trophic Index
N/A	Not Available / Not Applicable
NCSD	National Council for Sustainable Development
NCDM	National Committee for Disaster Management
NDC	Nationally Determined Contribution (UNFCCC)
NGO	Non-Governmental Organization
NIS	National Institute of Statistics
NO_2^- / NO_3^-	Nitrite / Nitrate
NPA	Natural Protected Area
NSDP	National Strategic Development Plan
NSOC	National State of the Oceans and Coasts
OECD-DAC	Organisation for Economic Co-operation and Development – Development Assistance Committee
PA	Protected Area

PAs	Protected Areas System
PCA	Principal Component Analysis
PEMSEA	Partnerships in Environmental Management for the Seas of East Asia
PPC	Provincial People's Committee
PPR	Primary Production Required
PPP	Public–Private Partnership
RGC	Royal Government of Cambodia
RIS	Ramsar Information Sheet
RLF	Responsible Landfill Facility
RPD	Relative Percent Difference
SAU	Sea Around Us (global fisheries database)
SAP	Strategic Action Programme
SCS–GOT	South China Sea–Gulf of Thailand
SCSSAP	South China Sea Strategic Action Programme
SDG	Sustainable Development Goal
SEZ	Special Economic Zone
SLR	Sea-Level Rise
SOC	State of the Coasts Report (PEMSEA)
SOP	Standard Operating Procedure
SPM	Suspended Particulate Matter
SSC	Suspended Sediment Concentration
TAC	Total Allowable Catch
TDA	Transboundary Diagnostic Analysis
TN / TP	Total Nitrogen / Total Phosphorus
TPH	Total Petroleum Hydrocarbons
TRI	Trawl Intensity Index
TSS	Total Suspended Solids
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WASH	Water, Sanitation and Hygiene
WB	World Bank
WEPA	Water Environment Partnership in Asia
WHO	World Health Organization
WWF	World Wide Fund for Nature
WWTP	Wastewater Treatment Plant

Table of Contents

List of Figures

List of Tables

Executive Summary

This National Report provides Cambodia's technical contribution to the South China Sea–Gulf of Thailand (SCS–GOT) Transboundary Diagnostic Analysis (TDA). It consolidates the most up-to-date evidence on socioeconomic conditions and climate risks, land-based and marine pollution, ecosystem status, fisheries dynamics, and governance capacity across Cambodia's coastal and marine systems, building on the Cambodia National TDA (2000) while integrating new datasets, expanded indicators, and improved analytical tools.

The report is designed to support national decision-making and inform regional cooperation by identifying priority issues, diagnosing drivers and causal chains, and providing an evidence base ready to support the Strategic Action Programme (SAP).

Approach and assessment frame

The updated National TDA applies the UNEP/GEF "concentric circles" framework to link (i) ecosystem condition, (ii) direct pressures (pollution, overfishing, habitat modification, climate hazards), and (iii) socioeconomic drivers and governance responses.

Analysis is organized across the four coastal provinces (Koh Kong, Preah Sihanouk, Kampot, Kep), key watersheds (including Mekong–Tonle Sap–Bassac and major coastal basins), and functionally distinct marine–coastal subregions such as the Sihanoukville urban–industrial coast, the Kampot–Kep estuary and seagrass corridor, Koh Kong mangrove–estuary complexes, and the Koh Rong archipelago.

A structured synthesis confirms six priority problem clusters and highlights where risks concentrate spatially and through reinforcing cross-sectoral feedback loops.

Key findings: Cambodia's priority problem clusters

1) Socioeconomic and livelihood risks are rising in fast-changing coastal provinces. The four coastal provinces host **more than 1.7 million people**, with **poverty around 17.8% (2019/20)** and a large near-poor group highly exposed to shocks. Livelihood dependence on ecosystems remains high, especially in Koh Kong where wetland households derive **65–90% of income** from wetland-based resources. These dependencies make environmental degradation an immediate welfare risk, not only a conservation concern.

2) Climate-related coastal risks are intensifying and multiplying other pressures. Sea level is projected to rise by **~11–20 cm by 2050**, threatening **>35,000 ha** of coastal settlements and rice fields. Flood impacts have affected **>200,000 people (2020–2022)**. Warming seas increase bleaching risk, with sea-surface temperature anomaly reported at **+0.8–1.1°C (2023)**. These hazards interact with weak urban drainage, reclamation, and ecosystem loss—raising exposure in precisely the areas where assets and people are concentrating.

3) Land-based sources dominate pollution, driving the most rapid deterioration in nearshore waters. The report finds that **>80–90% of pollutants** affecting coastal waters originate from land-based activities—untreated/partly treated wastewater, agriculture and aquaculture runoff, solid waste/plastics leakage, and industrial zones—producing severe degradation in estuaries and nearshore areas. Wastewater treatment coverage remains very limited in the coastal growth nodes (**<20% in Preah Sihanouk, <10% in Kampot, ~0% in Koh Kong and Kep**). Monitoring evidence indicates repeated microbial exceedances (**10^4–10^5 CFU/100 mL**) and industrial exceedances for parameters such as oil & grease and heavy metals in high-pressure zones. Plastic leakage is estimated at **>85,000 tonnes/year**, while the national recycling rate remains **~10–12%**.

4) Habitat degradation is reducing natural "infrastructure" and weakening resilience. Mangroves remain strategic for coastal protection and blue carbon but have declined from **~58,866 ha (2014) to ~55,355 ha (2025)** (~−6%). The report highlights Botum Sakor peat-mangroves (~4,768 ha) as a rare blue-carbon asset requiring "hydrology-first" protection to avoid irreversible carbon loss and weakened coastal defence. Seagrass systems (including ~11,500 ha in Kep–Kampot and major beds off Koh Kong and Preah Sihanouk areas) are extensive but highly sensitive to trawling and turbidity. Coral reefs show mixed condition: Koh Rong has ~30% mean live cover dominated by sediment-tolerant corals, while Kep retains high-cover pockets (e.g., Koh Seh ~64%), but cumulative pressure from turbidity, overfishing and bleaching is increasing.

5) Fisheries decline and trophic downgrading indicate ecological limits have been exceeded. Marine production is concentrated: the four coastal provinces contribute roughly a quarter of national catch, with Preah Sihanouk and Koh Kong supplying **~75–80%** of coastal production; sharks and rays have collapsed to single-digit tonnes. The fleet is dominated by small-scale vessels, but the system remains highly trawl-dependent: trawls and purse seines generate **~85–90%** of landings, with bottom trawls contributing **~55–60%**. Stock indicators show severe depletion, including a demersal trawl CPUE decline from **~173 kg/hr (1960s) to ~26 kg/hr**. Ecosystem indices (MTI, FiB, PPR) consistently indicate progressive food-web simplification and pressure beyond ecological capacity.

6) Governance frameworks have improved, but coordination and financial gaps constrain effective recovery. The assessment notes the presence of integration frameworks (e.g., ICZM) and coordinating roles, but persistent constraints remain—particularly for offshore mandates, enforcement/O&M financing, and complete marine spatial planning. The summary of governance gaps includes a pending marine mandate, limited operational oil-spill readiness, partial EIA compliance monitoring, and insufficient marine enforcement coverage relative to need.

Cross-cutting conclusion: reinforcing feedback loops and concentrated hotspots

Evidence across chapters indicates reinforcing feedback loops: pollution and habitat degradation reduce fisheries productivity and tourism value; declining incomes and limited alternatives intensify pressure on open-access resources; and weak enforcement allows continued stress, locking systems into a downward trajectory and increasing inequity. Spatially, risk concentrates into a limited number of zones where high ecological value overlaps with intense pressures and vulnerable communities—especially the **Koh Kong complex (Peam Krasop–Koh Kapik–Botum Sakor)** and the **Preah Sihanouk urban–industrial coast**, among other priority areas identified in the national risk synthesis. The TDA further substantiates these priority zones by mapping wastewater discharge hotspots, sediment plumes, trawl-incursion clusters, and cross-border pollution pathways (e.g., Tonle Sap–Mekong–Bassac; Kep–Ha Tien; Koh Kong–Trat), underscoring the need for coordinated national and regional responses.

Priority directions for action (national and regional)

Breaking the negative cycles requires coordinated action across wastewater, solid waste, fisheries, protected areas, land use, and climate policy, rather than isolated interventions. Key medium-term priorities include operationalizing marine spatial planning (MSP) with cumulative-impact thresholds and climate-risk layers, expanding and strengthening the MPA/MFMA system with sustained patrol/O&M budgets and routine monitoring, and strengthening climate adaptation systems through integration of national commitments into provincial plans and nature-based solutions.

Regional cooperation priorities include joint Gulf of Thailand oil-spill exercises and sensitivity mapping, strengthened transboundary stock assessments and IUU cooperation, and coordinated marine-litter source reduction and monitoring, aligned with regional mechanisms and emerging global frameworks.

Overall, the report confirms that Cambodia’s coastal and marine systems remain highly valuable but increasingly stressed. It provides an integrated, indicator-based diagnosis of the country’s priority problem clusters, identifies where risks concentrate, and offers a clear, evidence-ready foundation to support SAP design, investment prioritization, and strengthened cooperation across the SCS–GOT region.

1 Introduction

1.1 Aims of the National Report

This National Report provides Cambodia's technical contribution to the formulation of the South China Sea–Gulf of Thailand (SCS–GOT) Transboundary Diagnostic Analysis (TDA). It consolidates the most up-to-date evidence on socioeconomic conditions, climate-related threats, land-based and marine pollution, ecosystem status, fisheries dynamics, and governance capacity across Cambodia's coastal and marine systems. Building upon the Cambodia National TDA (2000), the report incorporates new datasets, expanded indicator frameworks, remote-sensing products, and enhanced analytical tools to reflect contemporary coastal realities and emerging risks. The assessment aims to support both national decision-making and regional cooperation, ensuring that Cambodia's priorities are accurately represented in the collective diagnosis of transboundary environmental issues.

The specific aims of this report are outlined below.

1.1.1 Inputs to the SCS–GOT TDA

- **Provide scientifically grounded national inputs** to the regional TDA, including updated indicators, spatial hotspots, problem hierarchies, and the underlying drivers of environmental degradation across Cambodia's coastal provinces.
- **Ensure that Cambodia's priority issues**—including land-based and marine pollution, ecosystem degradation, fisheries over-exploitation, climate-related hazards and hydrological changes—are systematically represented in the regional analytical framework.
- **Strengthen causal-chain assessment** by applying UNEP/GEF problem-tree methodology, linking immediate causes, underlying drivers, and deeper systemic pressures relevant to transboundary management.
- **Support harmonization of national evidence** with the regional SCS–GOT TDA structure, including the categorization of environmental problems, vulnerability assessments, and governance performance indicators.

1.1.2 Analysis to support SDG reporting and international commitments

- **Contribute to Cambodia's reporting on global frameworks**, particularly SDG 6 (clean water and sanitation), SDG 11 (sustainable cities), SDG 13 (climate action), and SDG 14 (life below water), by providing updated national data and coastal-marine indicators.
- **Support implementation of international and regional commitments**, including:
    - the United Nations Convention on Biological Diversity (UNCBD);
    - the UN Framework Convention on Climate Change (UNFCCC) and Cambodia's NDC 3.0;
    - the Kunming–Montreal Global Biodiversity Framework (30x30 target);
    - ASEAN environmental cooperation frameworks;
    - and PEMSEA's State of the Coasts (SOC) reporting requirements.
- **Provide an analytical evidence base for national planning instruments**, including the Circular Strategy for Environment (2023–2028), the Cambodia Climate Change Strategic Plan (CCCSP) 2024–2033, the Code on Environment and Natural Resources

(2023), sub-national development plans, and ongoing work toward marine spatial planning (MSP) and integrated coastal zone management (ICZM).

- **Strengthen policy coherence and investment planning** by identifying gaps, priority areas, and opportunities for climate-resilient, biodiversity-positive and blue-economy-aligned coastal development.

1.2 Major Water-Related Environmental Problems: Comparative Overview (2000 vs 2025)

2.1.1 Comparative assessment & overview

The Cambodia National TDA (2000) identified seven principal water-related environmental problems across freshwater and marine/coastal systems (UNEP/GEF & MoE, 1998). Twenty-five years later, these problem clusters remain but have generally intensified under rapid economic growth, urbanization, coastal development and climate change. The comparative assessment, Table 1-1 synthesizes updated evidence from recent national and sectoral assessments. See Annex 1-1 and Annex Table 1-1 for more detail and supplementary material and note.

The comparative assessment, Table 1-1 shows that Cambodia's core challenges have not improved; most have deepened. Coastal cities and SEZs have expanded faster than wastewater and solid-waste infrastructure, so centralized plants still treat only a small share of sewage—less than 20% in Preah Sihanouk, under 10% in Kampot and almost none in Koh Kong and Kep (MoE, 2023; ADB, 2023). Monitoring shows persistent exceedance of faecal-coliform standards (10^4–10^5 CFU/100 mL), elevated nitrate and phosphate, and industrial effluents near ports and SEZs that frequently exceed limits for oil and grease, TPH, lead and zinc (MoE, 2023; ADB, 2023).

Fisheries indicators point to long-term depletion: demersal trawl CPUE has declined from 173 kg/hr in the 1960s to about 26 kg/hr today, with ecosystem indices confirming a shift toward smaller, lower-trophic species and sharp reductions in sharks, rays and other high-value stocks (FiA, 2025; SAU, 2024).

Wetlands and coastal habitats remain vital for livelihoods but are increasingly degraded. In Koh Kapik–Peam Krasop, 65–90% of household income depends on wetland-based fisheries and resources, yet these systems are highly sensitive to drainage, roads and salinity intrusion (Ramsar Secretariat, 2012; Fauna & Flora, 2024; Ly et al., 2023). Mangrove mapping shows a net loss of around 3,500–4,000 ha since 2014, while coral cover at many nearshore sites has fallen to 6–10% and seagrass in Kampot–Kep has shrunk by about 20%, largely due to trawling, dredging, reclamation and turbidity (MoE, 2023, 2024; ADB, 2023).

Hydrological extremes are intensifying: floods remain Cambodia's most damaging hazard, droughts linked to ENSO and warming temperatures now affect millions of people, and salinity intrusion is advancing 5–7 km inland in some estuaries (NCDM & UNDP, 2021; World Bank, 2023; FiA, 2025).

At the same time, transboundary pollution from the Mekong–Tonle Sap–Bassac system continues to drive high nutrient and sediment loads to coastal waters, with TSS in the Bassac reaching about 2,030 mg/L during peak flows (MoE, 2023; ADB, 2023; World Bank, 2023).

Table 1-1 Comparative analysis of major water-related environmental problems (2000 vs 2025)

Problem Category (2000)	Status / Evidence in 2000 *(Baseline)*	Status / Evidence in 2025 *(Updated from Ch.2–6)*
Contamination of water quality – domestic & non-point pollution	Widespread organic pollution and domestic sewage from urban centers; no wastewater treatment systems in coastal provinces; elevated BOD/TSS; fertilizers and pesticides entering rivers and coast.	<20% wastewater treated in Preah Sihanouk; <10% in Kampot; almost none in Koh Kong/Kep. FC often 10^4–10^5 CFU/100 mL; NO_3^- 2.0–2.6 mg/L; PO_4^{3-} 0.7–0.8 mg/L. Industrial effluents exceed limits for oil & grease, TPH, Pb, Zn.
Overfishing and declining fish stocks (freshwater & marine)	Declining catches in Tonle Sap and coastal zones; destructive gears; over-exploitation documented but limited monitoring.	CPUE collapse: 173 kg/hr (1960s) to ~26 kg/hr (present). MTI decline; sharks/rays reduced to single-digit tonnes; small pelagics dominate >70% of catch. Chronic trawl pressure.
Habitat degradation – freshwater wetlands	Loss of wetlands due to agriculture, drainage, and conversion; key nurseries affected.	Wetland dependence remains high; peat-mangroves, floodplains under pressure; salinity intrusion shifting freshwater–brackish gradients; Koh Kong wetlands provide 65–90% of household income but highly sensitive.
Habitat degradation – mangroves, coral reefs, seagrasses	Coastal habitats mapped but poorly protected; early signs of mangrove loss and fishing impacts on reefs.	Mangroves declined 3,510–4,000 ha (2014–2025); coral cover 6–10% nearshore; seagrass decline ~20% in Kampot–Kep; habitat fragmentation affects productivity and resilience.
Flooding (freshwater) and hydrological variability	Floods and droughts significant; Tonle Sap reversals influence seasonal flows; low adaptive capacity.	Floods remain top disaster risk; droughts affect 2.5 million people; salinity intrusion advancing 5–7 km inland; climate extremes interact with land-use change.
Drought-related impacts (freshwater + agriculture)	Seasonal droughts impact rice production and domestic water supply; limited storage/infrastructure.	Drought intensifying under ENSO and warming oceans; rural and peri-urban households experience water shortages; aquaculture exposed to temperature and disease stress.
Transboundary pollution & river-coast linkages	Pollution carried by Mekong–Tonle Sap–Bassac system; high FC in Phnom Penh discharge zones.	Persistent nutrient/microbial hotspots at Phnom Penh confluence; TN/TP loads rising; sediment plumes reaching coastal estuaries; cross-border nutrient flows into Viet Nam delta remain significant.

Source: *Cambodia National TDA, 2000; ADB, 2023; MoE, 2023; FiA, 2025; SAU, 2024; NCDM & UNDP, 2021*

2.1.2 New threats emerging (post-2000)

New threats not assessed in the 2000 TDA have become major national priorities and now compound the legacy problems, as shown in Table 1-2. Climate change acts as a risk multiplier, with sea-level rise of about 11–20 cm projected by 2050, more intense rainfall and salinity intrusion 5–7 km inland in some estuaries (World Bank, 2023; UNDP & NCDM, 2023).

Plastic waste exceeds 730,000 t/year, with at least 14,000 t/year leaking to the coast and 120–350 microplastic particles/kg recorded in sediments at hotspot sites (ADB, 2023). Around 60% of inspected facilities near ports and SEZs are non-compliant with effluent standards, and hazardous and medical wastes still outstrip treatment capacity (ADB, 2023; MoE, 2013). Rapid urbanisation—urban population 39% in 2019—and reclamation in Sihanoukville have outpaced drainage and wastewater systems (PEAMSEA & MoE, 2019).

Aquaculture expansion to more than 330,000 t/year, with 25–30% of feed lost as waste, adds local nutrient and microbial loads and emerging AMR risks (FiA, 2025). At sea, MSP remains incomplete, fewer than 30% of MPAs are effectively patrolled and enforcement budgets are thin (ADB, 2023; PEAMSEA & MoE, 2019).

Land clearing, roads and coastal works have raised sediment inflows by >35% in parts of Koh Kong, with TSS in Kampot Bay often 250–320 mg/L during the monsoon (MoE, 2013; SCSSAP, 2020).

Together, these emerging issues make Cambodia's coastal risks more complex and interconnected, underscoring the need for modern pollution control, climate-resilient planning, stronger compliance and an operational MSP framework.

Table 1-2 New or Intensified Issues Not Explicitly Assessed in the 2000 TDA

New or Emerging Issue (Post-2000)	2000 Status	2025 Status
Climate change impacts (SLR, salinity intrusion, marine heatwaves)	Not assessed.	SLR +11–20 cm by 2050; salinity intrusion 5–7 km inland; coral bleaching events; urban flooding intensifying.
Marine plastics & microplastics	Not assessed.	>730,000 t/year plastic waste; >14,000 t/year coastal leakage; sediments 120–350 microplastic particles/kg.
Industrial & port-related pollution	Mentioned only briefly.	60% non-compliance near ports/SEZs; hydrocarbons, Pb, Zn exceed standards; hazardous/medical waste poorly controlled.
Urbanization pressure & land reclamation	Urbanization low (~16% in 1998).	Urbanization 39% (2019 Census); rapid reclamation in Preah Sihanouk; drainage systems inadequate.
Aquaculture nutrient/microbial loading	Small-scale aquaculture.	25–30% feed loss to water; disease outbreaks; antibiotics and AMR detected; high BOD in dense farming zones.
Governance gaps in enforcement & MSP	Fragmented mandates.	NCCMD sub-decree pending; limited patrol budgets; <30% of MPAs effectively managed; MSP not yet formalized.
Sedimentation/ turbidity from land-use change	Limited monitoring.	Sediment loads increased >35% in Koh Kong; high TSS in Kampot Bay (250–320 mg/L in monsoon).

Source: *MoE, 2013; PEAMSEA & MoE, 2019; SCSSAP, 2020; World Bank, 2023; UNDP & NCDM, 2023, ADB, 2023; FiA, 2025)*

1.3 Biogeophysical Setting

1.3.1 Geomorphology and Geological History

Cambodia's approximately 435 km coastline spans four provinces—Koh Kong, Preah Sihanouk, Kampot and Kep—and lies along the eastern margin of the Gulf of Thailand continental shelf (PEAMSAE & MoE, 2019). The coastal zone is shaped by Holocene sea-level fluctuations, deltaic and estuarine processes, and long-term tectonic stability, which together have produced a mosaic of low-lying plains, insular archipelagos and rocky headlands (SCSSAP, 2020).

Key geomorphic features include:

- **Extensive estuarine–mangrove complexes in Koh Kong**, notably Peam Krasop and Botum Sakor, formed on alluvial and marine clays delivered by the Tatai, Kah Bpow and other rivers (PEAMSAE & MoE, 2019; Ramsar Secretariat, 2012).
- **Fringing and patch reefs around the Koh Rong archipelago**, developed on granitic and metamorphic basement structures and influenced by strong tidal currents and seasonally high turbidity (SCSSAP, 2020).
- **Karstic limestone systems in Kampot**, which host aquifers, caves and rare groundwater-fed coastal wetlands and springs (PEAMSAE & MoE, 2019).
- **Barrier beaches, dunes and muddy tidal flats** along Preah Sihanouk, Kampot and Kep, shaped by monsoon-driven currents, wave action and longshore sediment transport within the Gulf of Thailand (MoE, 2013).

These geological foundations underpin the spatial distribution of habitats, fisheries productivity and sediment dynamics, and they strongly influence the coastline's differential vulnerability to erosion, storm surges and sea-level rise (World Bank, 2023).

1.3.2 Climatology, Present and Projected

Cambodia's coastal climate is governed by the Southwest (May–October) and Northeast (November–April) monsoons, which create distinct wet and dry seasons (World Bank, 2023). Orographic effects along the Cardamom Mountains enhance rainfall in Koh Kong and parts of Preah Sihanouk, while the relatively low-lying Kampot–Kep corridor is characterised by strong onshore winds and coastal squalls.

Key features of the present climate include:

- **Mean annual rainfall of about 2,000–4,000 mm** across the coastal provinces, with the highest totals in Koh Kong and the Cardamom foothills (MoE, 2019).
- **Mean sea-surface temperatures of 28–29°C**, with an increasing frequency of short-lived "heat spikes" during strong El Niño events (World Bank, 2023).
- **A rising incidence of extreme rainfall, flash floods and strong storm surges**, particularly during late monsoon months, affecting urban centres and low-lying estuaries (UNDP & NCDM, 2023).

Climate projections for mid-century, based on SSP2-4.5 and SSP5-8.5 scenarios, indicate that:

- **Air temperatures are expected to increase by approximately 1.3–1.8°C by 2050**, with more hot days and warm nights (World Bank, 2023).
- **Sea level in the Gulf of Thailand is projected to rise by about 11–20 cm by 2050**, depending on emissions pathways (World Bank, 2023).
- **Monsoon rainfall intensity is likely to increase**, raising the risk of urban flooding, landslides and flash floods in steep catchments (UNDP & NCDM, 2023).
- **Dry-season droughts are projected to intensify**, especially during strong ENSO phases, stressing water supply systems and rain-fed agriculture (World Bank, 2023).

These climatic shifts are expected to amplify existing ecosystem and livelihood vulnerabilities—exacerbating shoreline erosion and saline intrusion, increasing coral-bleaching risk, and heightening disaster exposure for coastal towns and rural communities (World Bank, 2023; UNDP & NCDM, 2023).

1.3.3 Biogeography, Endemic and Unique Marine Species

Cambodia's marine and coastal ecosystems form part of the Eastern Gulf of Thailand ecoregion and support a high diversity of habitats and species relative to the country's short coastline (PEAMSAE & MoE, 2019; SCSSAP, 2020). The coastline links the Cardamom Mountain forests, extensive mangroves and estuaries, coral reefs, seagrass meadows and offshore islands, creating important north–south and inshore–offshore ecological corridors. Key biogeographic characteristics include:

- **Mangroves**: Over 25 mangrove tree species have been recorded, including *Rhizophora apiculata*, *Avicennia marina*, *Sonneratia alba*, *Bruguiera gymnorrhiza* and *Ceriops tagal* (PEAMSAE & MoE, 2019; Ramsar Secretariat, 2012). These forests provide nursery habitat for fish and crustaceans, stabilise shorelines and store significant amounts of blue carbon.
- **Coral reefs**: Reefs are dominated by massive, sediment-tolerant genera such as *Porites* and *Favia*, reflecting naturally high turbidity and riverine influence (SCSSAP, 2020). Though generally of low to moderate relief, these reefs host diverse assemblages of reef fish and invertebrates and underpin local tourism and fisheries.
- **Seagrass meadows**: Eleven seagrass species have been documented, giving Cambodia the highest known seagrass species richness in mainland Southeast Asia (PEAMSAE & MoE, 2019). Extensive meadows in Kampot and Kep are critical feeding grounds for dugongs and green turtles and support small-scale fisheries.
- **Flagship and threatened fauna**: The coastal zone supports populations of Irrawaddy dolphin (*Orcaella brevirostris*, EN), green and hawksbill turtles (*Chelonia mydas*, EN; *Eretmochelys imbricata*, CR), dugongs (*Dugong dugon*, VU), smooth-coated otters (*Lutrogale perspicillata*, VU) and fishing cats (*Prionailurus viverrinus*, VU) (IUCN, 2023; PEAMSAE & MoE, 2019).
- **Fishery resources**: Demersal and pelagic finfish, crustaceans, cephalopods and molluscs are highly diverse, with coastal communities targeting small pelagics, penaeid shrimp, swimming crabs, squid and a wide range of reef-associated species (FiA, 2025; SAU, 2024).

Taken together, these ecosystems support coastal livelihoods, national food security, blue-carbon storage and biodiversity conservation. They also provide ecological connectivity between Cambodia and neighboring SCS–GOT countries, underlining the importance of cooperative management of shared stocks and transboundary habitats (ADB, 2023; SCSSAP, 2020).

1.4 Assessment Methodology

1.4.1 Conceptual Framework

The updated National TDA shifts emphasis from describing environmental "states" to **evaluating risks to ecosystems, people and livelihoods**, while also assessing the adequacy of governance responses. The assessment follows the UNEP/GEF **concentric circles framework**, adapted for Cambodia and linked to the regional SCS–GOT TDA–SAP process.

- **Inner circle – Ecosystem state**: condition and trends of mangroves, seagrass beds, coral reefs, wetlands, estuaries and offshore islands.
- **Middle circle – Direct pressures**: land-based and marine pollution, overfishing and destructive gears, habitat modification, aquaculture intensification and climate-related hazards (floods, droughts, storm surges, heatwaves).
- **Outer circle – Socioeconomic drivers and governance**: demographic change, urbanization, port and tourism development, agricultural expansion, investment patterns, legal and policy frameworks, institutional capacity and financing.

Within this structure, **quantitative and qualitative indicators** are used to trace causal chains from root causes and drivers, through pressures and state change, to impacts on human well-being and the effectiveness of policy responses. The same framework is applied across subnational units and, where possible, harmonized with regional indicators to enable comparison and "traffic-light" risk rating (green–yellow–red) at national and LME scales.

1.4.2 Subnational Geographic Divisions

The analysis is organized around spatial units that connect **watersheds, first-level administrative regions and coastal–marine ecosystems**:

1. **Coastal provinces** – Koh Kong, Preah Sihanouk, Kampot and Kep serve as the main units for socioeconomic, governance and climate-risk indicators (population, HDI/SHDI, IDPoor, urbanization, disaster losses, institutional capacity).
2. **Watersheds and river basins** – the Mekong–Tonle Sap–Bassac system and major coastal river basins (e.g. Tatai, Kah Bpow, Andong Tuek, Prek Thnot) are used to analyse land-based pollution, sediment and nutrient delivery to the sea, and to relate upstream drivers to coastal impacts.
3. **Marine and coastal subregions** – functionally distinct seascapes are defined for integrated analysis of ecosystems, pressures and governance:
    - Sihanoukville urban–industrial coast;
    - Kampot–Kep estuary and seagrass corridor;
    - Koh Kong mangrove–estuary complexes (Peam Krasop, Koh Kapik, Botum Sakor);
    - Koh Rong archipelago and associated reef systems.

Spatial overlays combine **population density, land cover, pollution hotspots, fishing effort, habitat condition and climate exposure** to identify high-risk zones and areas of transboundary significance.

1.4.3 Indicators by Component

Indicator selection was guided by four principles: **relevance to major water-related problems**, **consistency with 2000 baseline reports**, **alignment with regional TDA/SAP indicator guidelines**, and **availability and transparency of underlying data**. Evidence is presented through time series, maps and tables, with supporting data and metadata placed in chapter annexes and consolidated annex/appendices.

Socioeconomics and climate-related risk (Chapter 2)

- Population size, growth and density (national and coastal);
- HDI/SHDI and IHDI "penalty";

- Poverty and IDPoor incidence, livelihood dependence on fisheries and coastal resources;
- Urbanization rates and coastal asset concentration;
- Disaster events, deaths, affected people and economic losses.

Pollution (Chapter 3)

- Water-quality parameters: TN, TP, fecal coliform, COD/BOD, TSS, oil & grease, TPH, heavy metals;
- Municipal and industrial wastewater generation, treatment capacity and coverage;
- Solid waste generation, disposal and recycling;
- Plastic leakage estimates and marine debris density;
- Hazardous and medical waste, aquaculture effluents and identified pollution hotspots.

Ecosystems (Chapter 4)

- Mangrove extent and change since 2014;
- Coral cover and condition categories;
- Seagrass area and species richness;
- Wetland extent and key site characteristics;
- Occurrence of flagship and threatened species;
- Habitat integrity and fragmentation indicators.

Fisheries (Chapter 5)

- Catch-per-unit effort (CPUE) trends for demersal and pelagic fisheries;
- Mean Trophic Index (MTI), Fishing-in-Balance (FiB) and Primary Production Required (PPR);
- Reconstructed catch by species group and gear type (1950–2019);
- Spatial distribution of fishing effort and bottom-impacting gears;
- Aquaculture production, value and intensity indicators.

Governance (Chapter 6)

- Legal and policy instruments relevant to coastal and marine management;
- Institutional arrangements for ICZM, MSP and MPA management;
- MPA and MFMA coverage, management effectiveness and patrol effort;
- Economic instruments, budgets and financing for enforcement and conservation;
- Civil society participation, co-management arrangements and partnership initiatives.

1.4.4 Risk Assessment Approach

Risk levels are derived using a **three-pillar Exposure–Sensitivity–Adaptive Capacity (ESAC) framework**, consistent with international practice for climate and environmental risk assessment and with the regional indicator guidelines.

- **Exposure** reflects the presence and magnitude of hazards in each province or subregion—pollution loads, fishing pressure, development intensity, frequency of floods and droughts, and projected climate stresses (sea-level rise, temperature and rainfall changes).
- **Sensitivity** captures how strongly ecosystems and communities are affected by a given hazard, based on ecological fragility (e.g. coral sensitivity to bleaching,

mangrove degradation, seagrass turbidity thresholds), livelihood dependence on fisheries and wetlands, and concentrations of poor or highly exposed populations.

- **Adaptive capacity** assesses the ability of institutions, communities and sectors to anticipate, respond and adapt—considering governance effectiveness, enforcement capacity, financing, infrastructure (e.g. wastewater treatment, early warning), social protection and livelihood diversification.

For each indicator set, **direction and magnitude of change from the late 1990s baseline to the early 2020s** are assessed and, where possible, converted into **traffic-light risk ratings** (green = low, yellow = moderate, red = high). Comparative profiles across provinces and subregions highlight recurring hotspots such as:

- Peam Krasop–Koh Kapik mangrove–estuary complex;
- Sihanoukville urban and industrial coastline;
- Kampot–Kep seagrass and estuary corridor;
- The Phnom Penh–Bassac–Mekong discharge interface.

These risk profiles provide the bridge from diagnostic analysis to **prioritized strategic actions** in the forthcoming National and Regional SAPs, ensuring that proposed measures directly target the most critical combinations of pressures, vulnerabilities and governance gaps.

2 Socio-economics and Climate-related Threats

2.1 Key Findings

- **Coastal growth is fast but uneven.** Coastal population growth from 1998 to 2019 was fast but uneven at 1.3% per year, with Preah Sihanouk concentrating the most exposed assets.
- **Urbanization is accelerating:** the urban share rose from about 10% in 1950 to 24% in 2020 and is projected to exceed ~30% by the mid-2030s and ~40% by the mid-2040s, increasing exposure to urban and coastal flooding in fast-growing towns.
- **Human development has improved but remains unequal:** Cambodia's HDI reached 0.606 in 2023, yet inequality still cuts 27–29% off the inequality-adjusted HDI, and coastal SHDI has plateaued in some provinces since around 2015.
- **Poverty dropped from 33.8% in 2009 to 17.8% in 2019/20**, but COVID-19 likely added about 2.8 percentage points and coastal poverty is uneven, with Koh Kong and Kampot showing the highest intensity and Preah Sihanouk the lowest.
- **Economic diversification is rapid:** GDP grew from US$3.69 billion in 2000 to about US$46 billion in 2024 and GDP per capita from US$296 to US$2,628, with a shift toward industry and services concentrated in coastal hubs that now combine high growth with high exposure.
- **Disaster patterns are clear:** floods are the deadliest events, major droughts (such as 2016) have affected around 2.5 million people, and storms plus exceptionally high lightning fatality rates add compound risks for ports, estuaries and tourism towns.
- **Sea-level rise and warming seas are already stressing** reefs, seagrass, mangroves and beaches, threatening fisheries and coastal tourism unless natural buffers are protected and pollution and sediment loads are better managed.
- **Country risk is classified as "medium,"** with an overall disaster-risk score around 4.4/10, very high river-flood exposure (about 8.6/10) and limited coping capacity driving vulnerability.
- **Three binding coastal gaps remain:** (i) drainage, land-use planning and basic infrastructure lag behind hazard realities; (ii) ecosystem defenses such as mangroves, floodplains, dunes and reefs are fragmented; and (iii) inequality, informality and thin safety nets leave near-poor and migrants highly exposed.
- **Priority directions** include basin-to-coast flood management and early warning, risk-informed standards for urban growth and ports, large-scale restoration of mangroves and floodplains, drought-salinity water security, and investment in inclusive human development (TVET, health and MSMEs) for a more resilient coastal economy.

2.2 Current Status

2.2.1 Demographics

2.2.1.1. Population

Figure 2-1 shows Cambodia's national population grew from about 11.4 million in the late 1990s to 15.3 million in 2019 and an estimated 17.6 million in 2024, with recent growth around 1–1.3% per year; projections suggest ≈18 million by 2028 and ≈21 million by 2048 (NIS, 1998, 2008, 2019; WB–WDI, 2025).

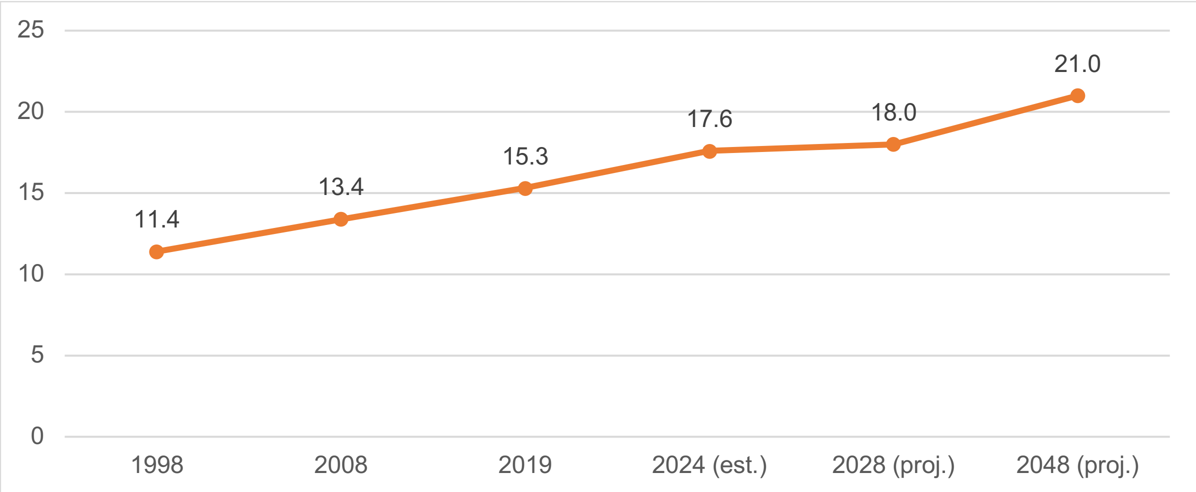

Figure 2-1 Cambodia's national population and projections (1998–2048)
Source: *NIS, 1998, 2008, 2019; WB–WDI, 2025*

Across the four coastal provinces (Figure 2-2), population increased from **0.845 million (1998) to 0.960 million (2008) and 1.072 million (2019),** while their share of the national total slipped from **7.4% to 7.2% to 6.9%** respectively. (NIS, 1998, 2008, 2019).

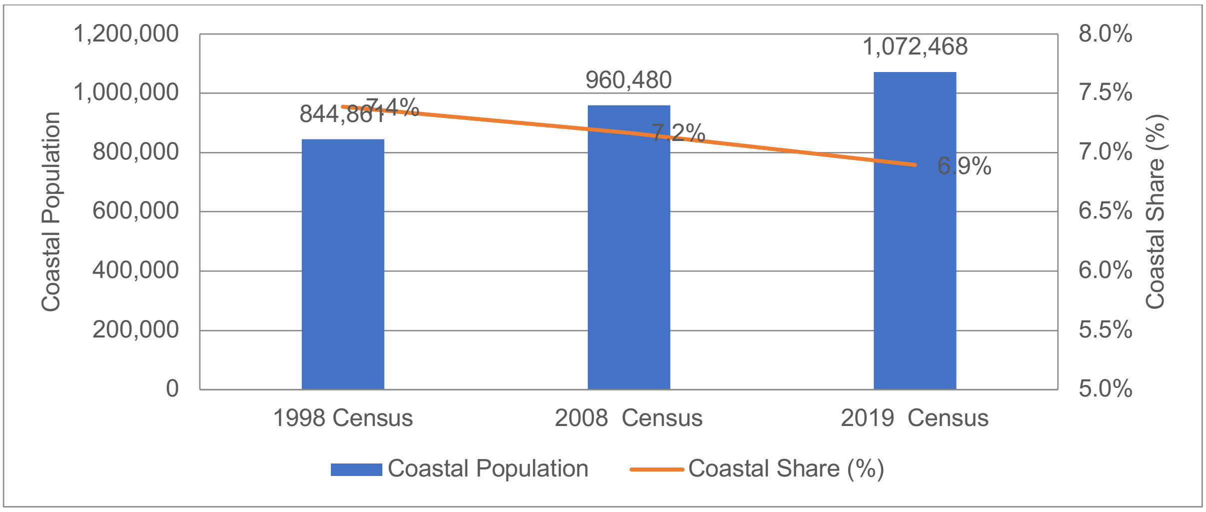

Figure 2-2 Coastal population and share of national total (1998–2019)
Source: *NIS, 1998, 2008, 2019*

Within the coast (Figure 2-3), Preah Sihanouk nearly doubled its population and households households grew faster than people, from **163,337 to 206,868 to 228,415** (+40%), indicating sustained household formation and in-migration to coastal hubs (Brinkhoff, 2019). Kampot grew modestly but its national share fell; Koh Kong shows slow net growth from a small base; and Kep remains tiny but recorded the fastest relative population and household gains. Average household size generally fell and sex ratios diverged—male-skewed in Preah Sihanouk and Koh Kong, more balanced or female-skewed in Kampot and Kep— total shows about **0.92–0.94**, reflecting different labour markets and migration patterns (NIS, 1998, 2008, 2019).

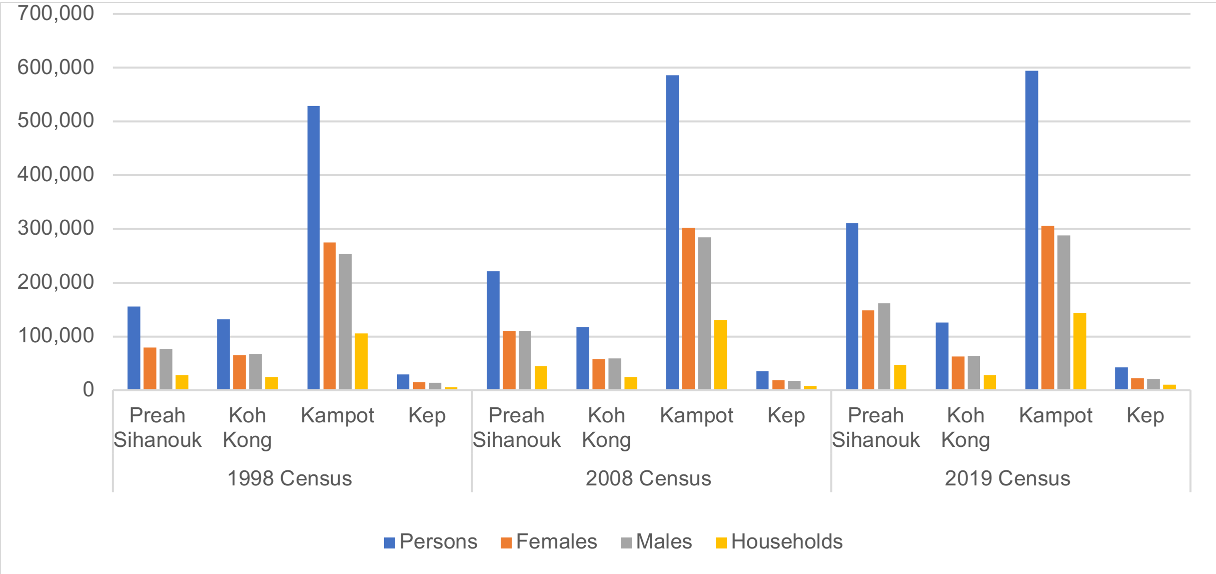

Figure 2-3 Coastal provinces – population and households (1998–2019)
Source: *NIE, 1998, 2008, 2019)*

2.2.1.2. Subnational coastal area and population densities

As show in Table 2-1, coastal provinces cover 17,237 km² (9.52% of national land), dominated by Koh Kong's large low-density area and the much smaller but denser Kampot, Preah Sihanouk, and Kep. Indicates that densities rose from 49 to 62 persons/km² (1998–2019), driven mainly by Preah Sihanouk's rapid growth, moderate increases in Kampot and Kep, while Koh Kong stayed sparse. Coast-wide population growth increased from 0.8%/yr to 1.0%/yr, led by accelerating growth in Preah Sihanouk, steady but slowing rates in Kep, minimal growth in Koh Kong, and near-zero growth in Kampot.

Table 2-1 Coastal provinces: area, density and growth

Province	Area (km²)	% of national land	Density (persons/km²)			Growth (%/yr)	
			1998	2008	2019	1998–2008	2008–2019
Koh Kong	10,090	5.57%	~12	~12	~12	0.12	0.60
Kampot	4,873	2.69%	108	120	122	1.03	0.10
Preah Sihanouk	1,938	1.07%	89	114	160	2.54	3.10
Kep	336	0.19%	85	106	127	2.21	1.60
Coastal average	17,237	9.52%	49	56	62	0.80	1.00

Source: *NIS, 1998, 2008, 2019*

2.2.1.3. Urbanization rate

Table 2-2 shows a long-term acceleration in urbanization—from roughly 10% in 1950 to 24% by 2020—with projections indicating the share will exceed 30% by the mid-2030s and could approach 40% by the mid-2040s. Growth was gradual until around 1990, then increased more rapidly after 2000, reaching 20% in 2010 and 24% in 2020.

Table 2-2 National urban share – key years and projections

Year	Urban share of population (%)	Note
1950	10.2	Pre-war baseline
1975	4.5	Conflict/forced evacuation anomaly
2010	20.3	Post-2000 acceleration
2020	24.2	Latest UN estimate
2025	26.5	Projection
2030	29.0	Projection
2035	31.8	Projection
2040	34.8	Projection
2045	37.9	Projection
2050	41.2	Projection

Source: *UN DESA, 2019*

Consistent with this trend (shown in Table 2-2), the national Census data (Figure 2-4) also record a sharp rise from 16% in 1998 to 20% in 2008, and then to 39% in 2019, reflecting both rapid urban expansion and intensified rural-to-urban migration during the past decade.

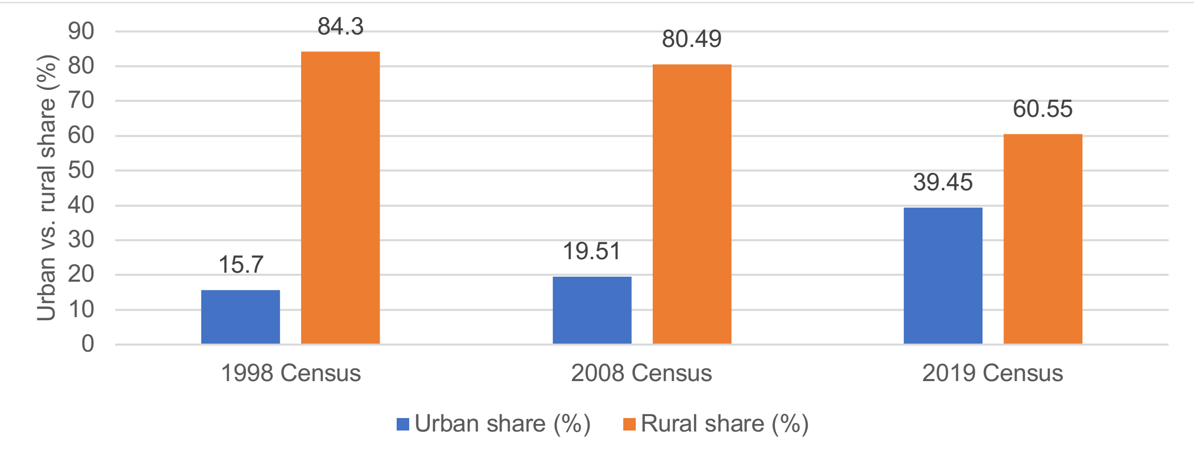

Figure 2-4 Census-based urban and rural shares – Cambodia (1998-2019)

Source: *NIS, 1998, 2008, 2019*

2.2.1.4. Built-up surface/area

Using Ouyang et al. (2016)'s 30-m urban map (Table 2-3), Cambodia's built-up land in 2010 is estimated at about 212.5 km² (≈0.12% of national area), with a likely range of 210.5–224.6 km². This implies roughly 13,000 people per km² of built-up land. The map—combining Landsat, DMSP/OLS nighttime lights and MODIS NDVI—shows development concentrated around Phnom Penh, with comparatively modest nationwide urban expansion relative to regional neighbors.

Table 2-3 Built-up land, 2010 (national)

Indicator	Value	Note
Central estimate of built-up area	212.5 km²	30-m urban map, 2010
Likely range of built-up area	210.5–224.6 km²	Allowing for classification uncertainty
Share of national land area (approx.)	≈0.12%	Very small physical footprint
Implied population density (built-up)	≈13,000 persons/km²	Concentrated in urban cores

Source: *Ouyang et al., 2016*

2.2.2 Human Wellbeing

2.2.2.1. Poverty and coastal poor

Poverty declined substantially—from 47.8% in 2007 to 13.5% in 2014 (World Bank, 2014), and further from 33.8% in 2009 to 17.8% in 2019/20—yet COVID-19 likely added about 2.8 percentage points, underscoring the vulnerability of near-poor, informal, and tourism-reliant households, including in coastal provinces (Karamba & Tong, 2022). Government cash transfers delivered through the IDPoor registry helped absorb part of this shock and are estimated to have prevented additional households from falling back into poverty (World Bank, 2022). The latest IDPoor dashboard, Figure 2-5 shows Koh kong with the highest number of poor persons (39%) and households (25%) and Kep with the least at 15% of individuals and 14% of households, being poor (MoP, 2025).

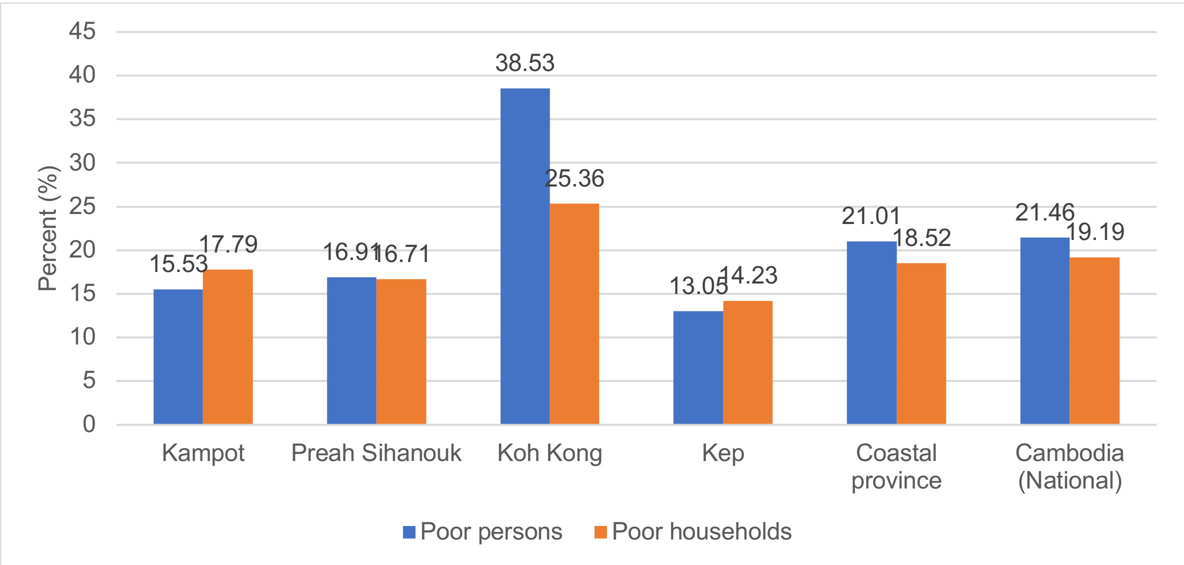

Figure 2-5 Poor rate by person and household (national vs coastal provinces)
Source: *Ministry of Planning (MoP), 2025. IDPoor public data query.*

Furthermore, a complementary lens from the MPI (Table 2-4) places Cambodia's national MPI around 0.070, with pronounced provincial variation along the coast: Koh Kong showing the highest deprivation (0.099), Kampot and Kep in the mid-range (0.079 and 0.075, respectively) and Preah Sihanouk the lowest (0.031), consistent with more urban/peri-urban pockets of need rather than widespread deprivation (OPHI & UNDP, 2024).

Table 2-4 Subnational (coastal province) Multidimensional Poverty Index

		Multidimensional poverty by region		
	MPI of the country	**Multidimensional Poverty Index (MPI = H*A)**	**Headcount ratio: Population in multidimensional poverty (H)**	**Intensity of deprivation among the poor (A)**
Subnational region	Range 0 to 1	Range 0 to 1	% Population	Average % of weighted deprivations
Kampot	0.070	0.079	19.35	40.59
Kep	0.070	0.075	19.20	39.08
Koh Kong	0.070	0.099	22.56	43.99
Preah Sihanouk	0.070	0.031	7.24	42.45

Source: *OPHI & UNDP, 2024*

2.2.2.1. Human Development Index

a) National HDI

Figure 2-6 indicates that Cambodia's HDI reached 0.606 in 2023, placing it in the medium human-development group and ranking 151st of 193 countries, down from 147th–148th in 2021–2022 (UNDP, 2024). The HDI has risen steadily from 0.387 in 1990 to 0.438 (2000), 0.543 (2010), 0.562 (2015) and 0.595 (2020), dipped slightly during COVID-19, and recovered to 0.602 in 2022 and 0.606 in 2023—showing long-term progress with only a brief pandemic setback.

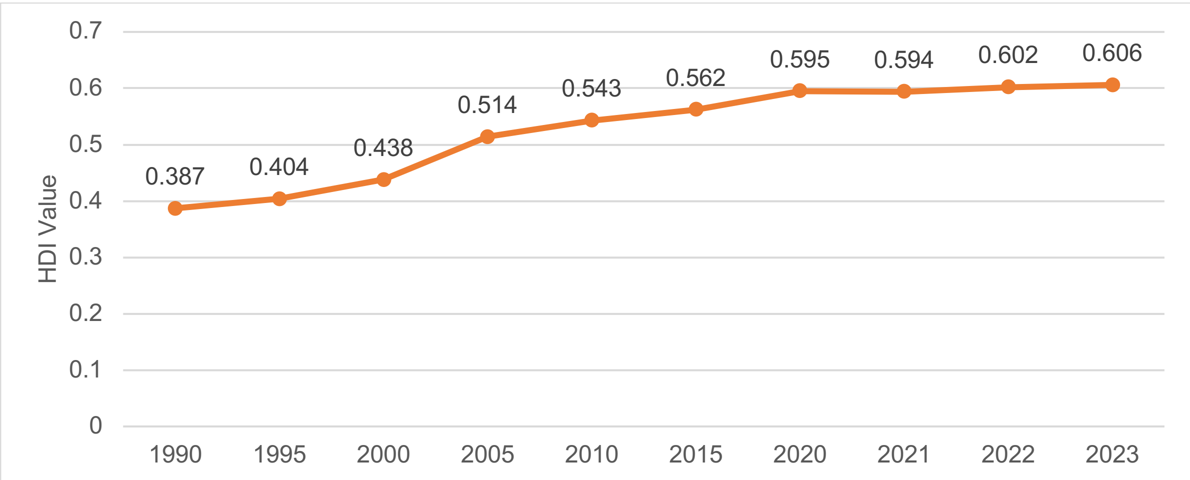

Figure 2-6 Cambodia Human Development Index (HDI) 1990-2023
Source: *UNDP, 2024. Human Development Report 2023/24 – Statistical Annex. Data Center*

Human development indicators show sustained long-term improvement, though several components have begun to level off (UNDP, 2024. Human Development Report 2023/24; see Annex Table 2-6 for full series and more detail).

The data shows that **life expectancy** increased from its lowest level of 55.2 years in 1990 to a pre-pandemic high of 70.1 years in 2020, dipped slightly during COVID-19 (69.3 in 2021), and reached 70.7 years in 2023, the highest on record. **Education indicators** also strengthened: **expected years of schooling** rose from a low of 6.9 years in 1990 to a peak of 11.8 years around 2014, before stabilizing at 11.2 years in 2023; **mean years of schooling** increased steadily from 2.8 years (1990) to a current high of 5.2 years (2021–2023), showing continued gains in attained education but slower progress since 2021. **Income** growth has been especially strong, with GNI per capita (2021 PPP$) rising from US$1,210 in 1990 to a pre-COVID high of US$4,415 in 2020, recovering after a mild pandemic dip to reach US$4,931 in 2023, the highest recorded level.

Despite these advances, inequality still reduces overall achievements: Cambodia's inequality-adjusted HDI (IHDI) shows a 27–29% loss relative to the headline HDI across the 2010–2023 period. The gap narrowed modestly—from a maximum loss of 28.8% in 2010 to 26.8% in 2023—indicating gradual yet incomplete progress in distributing health, education, and income gains more evenly.

b) Subnational Coastal HDI

Subnational HDI data (Figure 2-7) show long-term coastal gains but a post-2015 plateau (Global Data Lab, 2025). See Annex Table 2-7 for more full series and more detail of the **subnational HDI.** For **Preah Sihanouk–Kampot–Kep,** SHDI rose from 0.378 (1990) to 0.573 (2022), driven by higher life expectancy (55.2 to 68.4 years) and rising education levels. Expected years of schooling peaked in 2014 (11.8) before dropping to ~10, and life expectancy slipped during COVID-19, flattening SHDI near its recent high. For **Koh Kong**, SHDI increased from 0.368 (1990) to 0.548 (2022), with life expectancy improving (58.8 to 70.5 years) and mean years of schooling rising. Expected schooling fell sharply after its 2014 peak (12.46 to 8.35), pulling SHDI down from 0.585 (2014) to ~0.548, reflecting shorter schooling trajectories for younger cohorts and modest COVID-period mortality effects.

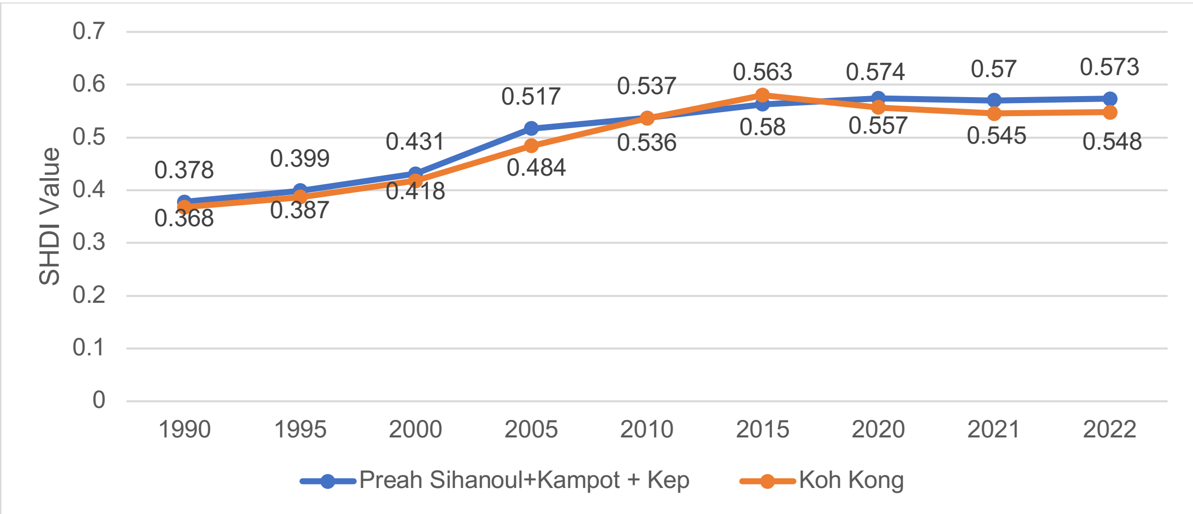

Figure 2-7 Subnational Human Development Index (HDI)-Cambodia 1990-2023
Source: *Global Data Lab, 2025.*

2.2.3 Economic Activities

2.2.3.1 Gross Domestic Product (GDP)

Cambodia's economy expanded strongly, with Gross Domestic Product (GDP) rising from US$3.69 billion in 2000 to US$46.35 billion in 2024 (current US$), with average annual growth at 7%. Annual growth was in double digits during the mid-2000s (9.5%–13.3% in 2004–2007), eased to high single digits through 2011–2019 (7.3%–8.8%), contracted -3.56% in 2020 during COVID-19, and then recovered at 3.09% (2021), 5.13% (2022), 5.01% (2023), and 6.02% (2024), with a 2025 projection of 4.0%. (WB–WDI, 2025).

Figure 2-8 shows Cambodia's GDP per capita in current and 2015 US$. GDP per capita rose from US$296 in 2000 to about US$2,628 in 2024, with three clear phases: a rapid rise from

2000–2007 (US$296→732), steady growth through 2011–2019 to roughly US$2,226, a COVID-19 dip to about US$2,082 in 2020, and a strong rebound to new highs by 2024. Key milestones include passing US$1,000 around 2011 and US$2,000 by 2018, reflecting sustained structural shifts toward industry and services and a resilient post-pandemic recovery (WB-WDI, 2025).

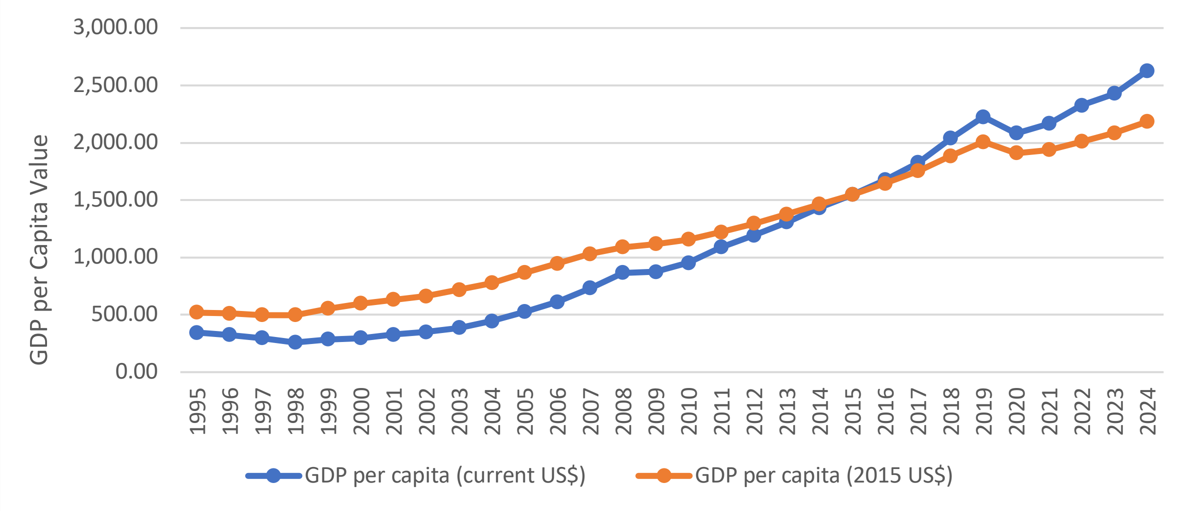

Figure 2-8 Cambodia GDP per Capita (Current US$ vs Constant 2015 US$) 1995-2024

Source: *World Bank, 2025. World Development Indicators (WDI)*

2.2.3.2 Agriculture, forestry, and fishing revenue

Agriculture continues to employ a large share of workers and remains climate-sensitive, while industry (especially garments/footwear) and services (tourism, logistics) continue to anchor growth. Agriculture, forestry and fishing's share of GDP fell from 47.7% (1995) to 16.6% (2024), but real value added still climbed from US$2.26 billion to US$5.30 billion (WB-WDI, 2025). In other words, the sector grew in absolute size even as the broader economy diversified. See Annex Table 2-9 for more detail.

Point estimates for fisheries & aquaculture span about 1.14% of GDP in 2014 (World Bank, 2023a) to ~5% in 2019 (PEMSEA & MoE, 2019). Moreover, according to the Fisheries Administration (FiA), Cambodia produced roughly 900,000 tonnes of fish (including aquaculture) in 2018, worth about USD 1.8 billion and contributing 8–10% of GDP (FiA, MAFF, 2020). 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). Beyond recorded trade, a sizable volume of high-value marine products, notably finfish, shrimp, and squid, reportedly moves informally across the borders with Thailand and Viet Nam and is not captured in official statistics (UNIDO/MAFF, 2015).

2.2.3.2 Service and tourism revenue

Services expanded from US$1.95 billion in 1995 to US$13.97 billion in 2024 in constant prices, around 7% real CAGR. The services share hovered near 39–42% through 2019, slipped during 2020–2021 (around 36–39%), and, despite output growth, remained lower at 35.6% in 2024, indicating the composition has not fully normalized post-pandemic (WB-WDI, 2025). See Annex Table 2-9 for more detail.

Tourism is becoming an increasingly significant part of Cambodia's economy, with beaches and offshore islands serving as major visitor magnets, mainly activity concentrated in Kampot and Preah Sihanouk. Sustained growth depends on the health of coastal ecosystems—especially coral reefs, beaches, and seagrass beds (MoE & NCSD, 2022). Preah Sihanouk hosts the main deep-sea port and a tourism hub; Kampot and Kep combine agro-processing and cultural/ecotourism; Koh Kong anchors mangrove/coastal tourism and fisheries. Ministry of Tourism reporting shows a strong rebound in coastal arrivals since 2023, led by Preah Sihanouk (MoT; WTTC). In 2016, Preah Sihanouk Province alone welcomed nearly 2.4 million tourists, which generated US$96 million in revenue (PEMSEA & MoE, 2019). Pre-COVID, tourism averaged approximately 17% of GDP (2010–2019), reinforcing that shocks and rebounds in tourism heavily influence national cycles (World Bank, 2023).

Spalding et al. (2017) estimate Cambodia's reef-related visitor expenditure at US$18.3 million/year, compared with US$2.104 billion in total visitor spending—about 0.87% of national tourism spending. Using the same reference year for tourism GDP, reef tourism therefore contributes roughly 0.87% of tourism GDP and about 0.13% of national GDP. Although modest in national terms, the average value of ~US$158,000 per km² of reef highlights the high local importance of reef sites for snorkeling, diving, beaches and reef-sheltered coastal destinations (Spalding et al., 2017, Table A1).

2.2.4 Climate-related Threats

Cambodia is highly exposed to floods, droughts and typhoons, which are becoming more frequent and damaging to people, infrastructure and food security (CFE-DMHA, 2024). Mortality peaks in large riverine floods, people-affected peaks in drought years, and both hazards generate major economic losses, with storms adding concentrated coastal damage. Floods mainly hit lowland basins, while droughts are geographically widespread (MoE & NCSD, 2022). Coastal provinces appear in all three hazard types, underscoring the need for an integrated portfolio of basin floodplain management, urban drainage, nature-based defenses, drought-water security and storm-resilient infrastructure and evacuation. See Annex Table 2-11 for summary of major climate- and weather-related disasters in Cambodia, 2000–2023.

2.2.4.1 Floods

Floods remain Cambodia's most lethal climate hazard, and the frequency of severe floods has increased over the last decade. The largest riverine floods, especially 2000, 2011, and 2013, caused extreme mortality and widespread disruption. EM-DAT records for 2000 indicate 347 deaths and 3.45 million people affected; for 2011, 247 deaths, 1.64 million affected, and about US$521 million in damages (about $726.561 million adjusted); and for 2013, 200 deaths and 1.50 million affected, and $500 million damages ($673.276million adjusted) (CRED, UCLouvain, 2025).

The 2011 event aligns with the CFE-DM history: heavy Mekong flooding affected 18 provinces, caused ~250 deaths, displaced ~52,000 households, and produced an estimated US$630 million in damages (CFE-DMHA, 2024). The 2013 floods impacted 20 provinces, affected more than 1.7 million people, and caused 188 deaths, with over 144,000 evacuees (CFE-DMHA, 2024). In October 2020, flash floods again underscored systemic exposure, affecting ~176,000 households across 14 provinces and damaging homes, public infrastructure, and farmland (CFE-DMHA, 2024). Although post-2015 floods have generally been less deadly, events such as 2019 and 2022 show continuing high exposure across the Mekong–Tonle Sap–Bassac system and into coastal provinces including Koh Kong, Preah Sihanouk, and Kampot (CRED, UCLouvain, 2025).

2.2.4.2 Drought

Drought produces the largest single-year populations affected and recurring livelihood shocks. According to EM-DAT dataset, major episodes include 2001 (approximately 300,000 affected), 2002 (about 650,000 affected; $38 million, about $66.3 million adjusted), 2005 (approximately 600,000 affected), and a pronounced 2016 event (about 2.5 million people affected) (CRED, UCLouvain, 2025).

The CFE-DM history similarly documents 2011–2012 agricultural drought (damage to rice fields across 11 provinces) and the 2015–2016 El Niño drought affecting at least half of districts and 18 provinces, with 2.5 million people impacted and significant crop and water-supply losses (CFE-DMHA, 2024). While primarily inland, these droughts repeatedly touch coastal provinces and supply chains, underscoring needs for resilient water storage, drought-tolerant inputs, and shock-responsive safety nets.

2.2.4.3 Storms & Tropical cyclones

Storms are episodic but increasingly costly. Cambodia experiences tropical cyclones or their remnants about six times per year between April and November (World Bank, 2023b). Even when landfall is indirect, associated floods, storm surge and lightning create compound risks for low-lying ports, estuaries and tourism towns (CRED, UCLouvain, 2025). EM-DAT notes, for example, a 2009 cyclone season with 17 deaths and 178,000 people affected, and 2020 storms causing 44 deaths, more than 750,000 affected and around US$100 million in damage, including in Koh Kong and Preah Sihanouk (CRED, UCLouvain, 2025).

Typhoon **Ketsana (2009)** alone caused about 43 deaths, major damage to houses, rice crops and infrastructure, with recovery needs estimated near US$191 million (CFE-DMHA, 2024; MoE & NCSD, 2022). Transboundary events such as the 2018 Xe-Pian Xe-Namnoy dam failure in Lao PDR led to evacuations and deaths in northern Cambodia without a shared early-warning system (CFE-DMHA, 2024). Recent years add storm surge and extreme lightning (e.g. 16 deaths from storm surge in 2022; over 14,000 people affected by lightning in 2023), underlining high compound risk from wind, surge, flash flooding and lightning in both inland and coastal areas (CRED, UCLouvain, 2025; AHA Centre, 2022).

2.2.4.4 Sea-Level Rise (SLR)

Cambodia's coastal zone is vulnerable to Sea-Level Rise (SLR), seawater intrusion, storms, floods, pests in agriculture production, and contaminated drinking water (MoE & NCSD, 2022). Sea-level rise and warming seas intensify coastal risks. The handbook notes rising temperatures and changes in sea level and hydrological cycles that threaten productivity in fisheries and other climate-sensitive sectors—directly relevant to Cambodia's Gulf of Thailand coastline and coastal livelihoods (CFE-DMHA, 2024).

2.2.4.2 INFORM Risk Index (mid-2025)

Cambodia's disaster risk is assessed as ***"medium,"*** ranking **59th of 191** countries with an overall INFORM score of 4.4/10 (mid-2025). As shown in Table 2-5 the Hazard & Exposure score is moderate (3.2/10), but river-flood risk is very high at 8.6/10—the dominant driver—reflecting intense monsoon rainfall, upstream releases, and extensive floodplain settlement that ultimately connects to coastal drainage systems. Drought risk is moderate (4.2/10), while tropical-cyclone exposure remains low (1.8/10) because Cambodia typically experiences only peripheral storm effects. Coastal-flood risk is lower in the index (3.7/10) yet still consequential for ports, estuaries, and tourism towns under rising seas. Cambodia's overall rating is elevated mainly by limited coping capacity (5.6/10) and population vulnerability (4.8/10) (European Commission, JRC & IASC, 2025).

Table 2-5 Selected indicators from the INFORM Risk Index (mid-2025) – Cambodia

INFORM RISK	RISK CLASS	Rank	HAZARD & EXPOSURE	River Flood	Tropical Cyclone	Coastal flood	Drought	VULNE-RABILITY	LACK OF COPING CAPACITY

(0-10)	(Very Low-Very High)	(1-191)	(0-10)	(0-10)	(0-10)		(0-10)	(0-10)	(0-10)
4.4	Medium	59	3.2	8.6	1.8	3.7	4.2	4.8	5.6

Source: *European Commission, Joint Research Centre (JRC), & Inter-Agency Standing Committee (IASC). (2025). INFORM Risk Index: Results and data (Mid-2025 update)*

2.3 Discussion and Conclusions

2.3.1 Risk assessment from socioeconomic trends

Coastal Cambodia is undergoing rapid but uneven demographic and economic change, which shapes who is at risk and where. Population in Preah Sihanouk, Koh Kong, Kampot, and Kep rose by about 27% between 1998 and 2019, while households grew ~40%, a pattern that signals smaller family size and sustained in-migration to coastal hubs (NIS, 1998; NIS, 2008; NIS, 2019). Within this growth, Preah Sihanouk concentrates the largest bundle of exposed assets, a deep-sea port, logistics platforms, and tourism infrastructure, amid a distinctly male-skewed sex ratio linked to construction and service inflows (NIS, 2019). By contrast, Koh Kong remains ecologically extensive and low-density, where scattered settlements face long response times and reliance on river/road crossings during floods (NIS, 2019; CFE-DMHA, 2024).

Human development has improved steadily—Cambodia's HDI rose to 0.606 in 2023 after a brief pandemic dip—but inequality still trims ~27–29% off the headline HDI when adjusted for distribution, indicating that shocks (floods, droughts, price spikes) can push near-poor households back into poverty (UNDP, 2024). Monetary poverty fell from 33.8% (2009) to 17.8% (2019/20), before COVID-19 raised poverty by ~2.8 percentage points, especially among informal and tourism-reliant workers (Karamba & Tong, 2022). Administratively targeted IDPoor data show coastal incidence close to the national average—about 21.0% persons vs 21.5% nationally—but with sharp intra-coastal contrasts: Koh Kong has the highest intensity, Kampot the largest caseload, Preah Sihanouk the lowest rates, and Kep small but non-trivial pockets (MoP, 2025). A complementary MPI lens confirms this spread (national MPI ≈ 0.070; Koh Kong 0.099, Kampot 0.079, Kep 0.075, Preah Sihanouk 0.031), implying different policy mixes are needed across provinces (OPHI & UNDP, 2024).

Urbanization is rising (projected ~30% by mid-2030s and ~40% by mid-2040s), but drainage, zoning, and worker housing have not fully kept pace in fast-growing nodes, increasing exposure to pluvial and coastal flooding (UN DESA, 2018). Economically, the national shift from agriculture to industry/services has lifted incomes—GDP per capita rose from US$296 (2000) to US$2,628 (2024)—but it also concentrates risk where tourism, ports, and logistics cluster along the shore (World Bank, 2025). In short, coastal risk is amplified by where growth occurs (asset concentration) and who participates (informal workers, migrants, and near-poor households).

2.3.2 Risk assessment from climate- and environment-related threats

Cambodia's economic growth relies on climate-sensitive sectors, agriculture, tourism, forestry, fisheries, and water resources. Combined with population and infrastructure vulnerabilities, this dependence makes the country highly exposed to climate change impacts, especially the natural disasters and hazards. Floods are the dominant lethal hazard. Benchmark riverine events in 2000, 2011, and 2013 caused heavy mortality and millions affected; 2011 alone led to ~247 deaths and US$521 million in losses, while 2013 affected ~1.5 million people (CRED, UCLouvain, 2025). The CFE-DMHA history documents 2011 flooding across 18 provinces with ~US$630 million in damages and 2013 flooding across 20 provinces with 188 deaths (CFE-DMHA, 2024). Even in recent years, 2019 and 2020 flash floods affected large populations and infrastructure, underscoring basin-to-coast connectivity (CFE-DMHA, 2024).

Drought is the largest "people-affected" hazard. EM-DAT records multi-hundred-thousand to multi-million persons affected (e.g., ~2.5 million in 2016 during an El Niño episode) across nearly all agro-ecological zones—impairing farm output, rural water supply, and inland fisheries that feed coastal markets (CRED, UCLouvain, 2025). CFE-DMHA similarly notes 2011–2012 agricultural drought and 2015–2016 nationwide drought affecting at least half of districts, with significant rice and water-supply losses (CFE-DMHA, 2024).

Storms, tropical cyclones, and lightning create compound risks, especially for ports, estuaries, and tourism towns. Cambodia typically receives fringe effects rather than direct landfalls, but six tropical cyclones on average each year pass through the broader season; in 2020, storms caused 44 deaths and ~US$100 million in losses, and Noru (Sept 2022) caused 16 fatalities via Mekong flooding (World Bank, 2023; AHA Centre, 2022; CRED, UCLouvain, 2025). Cambodia's lightning death rate (≈7.8 per million) is among the world's highest, with severe single-month clusters (CFE-DMHA, 2024).

Sea-level rise (SLR) and warming seas are slow-onset, system-wide threats, raising coastal flood baselines, intensifying salinity intrusion in dry seasons, and stressing coral, seagrass, and fisheries that underpin coastal livelihoods and tourism (MoE & NCSD, 2022). The INFORM Risk Index (mid-2025) integrates these drivers into a country profile of 4.4/10 (rank 59/191, medium), with very high river-flood exposure (8.6/10), moderate drought (≈3.7–4.2/10), and lower tropical-cyclone and coastal-flood exposure, while overall risk is pulled up by limited coping capacity (5.6/10) (European Commission JRC & IASC, 2025).

2.3.3 Mitigating socioeconomic vulnerability from climate-mediated environmental change – current actions and gaps

In response to the overlapping risks, **Cambodia has begun to build a more shock-responsive social protection and disaster-risk management system**. During COVID-19, the government rapidly expanded social assistance using the IDPoor registry, delivering cash transfers to hundreds of thousands of poor and newly poor households. This helped cushion pandemic-related poverty reversals, while upgrading the social registry, payment systems, and local delivery mechanisms that can now be repurposed for future climate- and disaster-related shocks (World Bank, 2022; Karamba & Tong, 2022). These foundations are particularly relevant in coastal provinces where tourism, fisheries, and construction workers—many informal or migrant—face high income volatility during floods, storms, and economic downturns (MoP, 2025; OPHI & UNDP, 2024).

On risk governance, institutional frameworks for disaster risk reduction (DRR) have strengthened, notably through the **Law on Disaster Management** and the **National DRR Strategy 2019–2030**, which clarify mandates for the National Committee for Disaster Management and sub-national committees (CFE-DMHA, 2024). The INFORM Risk Index reflects this with relatively lower institutional sub-scores compared with hazard exposure, indicating improving, though still constrained, coping capacity (European Commission JRC & IASC, 2025). Cambodia is also piloting impact-based forecasting and early warning with regional partners, which, if scaled, can better link hydro-meteorological information to anticipatory action in flood- and storm-prone basins (CFE-DMHA, 2024).

Ecosystem-based adaptation is another emerging pillar. Expansion and consolidation of protected areas and community-managed zones have reinforced mangrove, seagrass, and estuarine conservation, particularly in Koh Kong's Peam Krasop Wildlife Sanctuary and Koh Kapik Ramsar Site, where mangroves provide critical blue-carbon storage and natural shoreline protection (MoE & NCSD, 2022). These measures, alongside community-based ecotourism and sustainable fisheries initiatives, can simultaneously buffer hazards and diversify livelihoods if backed by long-term financing and enforcement.

Infrastructure investments are reshaping both exposure and response capacity. Port, road, and grid upgrades in Preah Sihanouk and along coastal corridors have reduced travel time, improved market access, and enabled faster emergency deployment, especially where climate-resilient design standards are applied (CFE-DMHA, 2024; World Bank, 2023). However, as discussed below, such growth corridors also attract dense settlements and assets, increasing potential losses when risk-informed land-use planning is weak (UN DESA, 2018; NIS, 2019). Cambodia's updated climate commitments and national strategies explicitly prioritise strengthening adaptation capacity—including DRR, preparedness, and recovery for coastal, Tonle Sap, and Mekong communities—creating a policy window to align social protection, DRR, ecosystem management, and infrastructure planning (RGC, 2024).

Despite the progress made so far, important gaps remain, as following:

Exposure and planning: Urban growth is outpacing drainage, zoning, and worker-housing codes in coastal towns; informal and peri-urban settlements on low-lying or steep land remain exposed to pluvial and coastal floods, landslides, and water contamination (UN DESA, 2018; NIS, 2019; CFE-DMHA, 2024). Risk information (e.g., flood maps, CCRI, hazard histories) is not yet consistently embedded in coastal SEZ plans, tourism zoning, or housing policy.

Ecosystem buffers: Mangrove belts, floodplains, dunes, and coral-reef systems are fragmented or stressed by sediment imbalance, wastewater, sand mining, and shoreline hardening, undermining natural protection and tourism asset quality (MoE & NCSD, 2022). Restoration projects and community conservation are expanding but remain small relative to the historical scale of ecosystem loss, with uneven enforcement outside core protected areas.

Compound-risk intelligence and early action: Flood and storm early-warning systems have improved, but forecast chains are not yet fully integrated: river releases, extreme rainfall, dam operations, tides/surge, and urban drainage are still modelled and managed largely in silos, limiting timely evacuation, anticipatory cash support, and port or logistics continuity planning (CFE-DMHA, 2024; World Bank, 2023). Early-warning messages often remain hazard-based rather than impact-based, and sub-national capacities to interpret and act on forecasts are variable.

Human development and livelihoods: Despite HDI gains, the IHDI penalty (~27–29%) and MPI disparities show that near-poor, migrants, and informal workers have thin buffers; they require predictable safety nets, skills/TVET for resilient jobs, and access to health services before, during, and after disasters (UNDP, 2024; OPHI & UNDP, 2024; Karamba & Tong, 2022). Existing programmes are still more reactive than anticipatory, and coverage of urban informal workers and seasonal migrants in coastal areas remains incomplete (MoP, 2025; World Bank, 2022).

Indeed, progress in social protection, DRR institutions, and ecosystem conservation is real, but infrastructure, ecosystems, and social inclusion remain the binding constraints at the coast. Addressing these will determine whether coastal growth pathways reduce or magnify climate-mediated socioeconomic vulnerability.

2.3.4 Recommended priority actions, including regional cooperation

a) Risk-informed urban/port resilience in coastal hubs

Coastal cities and port zones should prioritize drainage and floodproofing by expanding separated stormwater networks, increasing detention and retention capacity, and upgrading tide valves in Sihanoukville, Kampot, and Kep, while using design floods that explicitly reflect river–rain–tide–surge interactions. At the same time, stronger codes and land-use controls are needed to enforce setbacks and elevation standards, require hotel and warehouse continuity planning, and formalize worker housing with minimum heat and flood safety provisions.

b) Basin-to-coast flood management

Flood risk management should be strengthened through joint protocols for upstream reservoir releases and cross-border early warning—recognizing that the 2018 Xe-Pian Xe-Namnoy failure exposed current coordination gaps—paired with downstream surge and tide forecasting. These measures should be made operational through regular compound-risk drills involving ports and municipalities.

c) Nature-based defenses and blue-economy safeguards

Risk reduction should be reinforced by restoring mangroves and floodplains, protecting coastal dunes, and improving sediment and wastewater management, alongside piloting reef-positive tourism. Together, these actions help protect the natural capital—reefs, seagrass, and beaches—that underpins the coast's competitiveness.

d) Drought and salinity resilience

Coastal deltas should scale small- and medium-scale water storage, establish salinity barriers and monitoring, and expand drought-tolerant crops and aquaculture. To reduce livelihood shocks during dry-season shortfalls, shock-responsive cash support through IDPoor should be maintained for near-poor households.

e) Inclusive human development and livelihoods

Reducing the IHDI penalty requires investment in secondary and TVET completion, improved coastal health access, and MSME diversification linked to port and tourism economies. In parallel, migrant inclusion should be strengthened across early warning systems, access to shelters, and post-disaster assistance.

f) Regional cooperation (Gulf of Thailand LME & Mekong)

Regional partners should improve hydro-meteorological data sharing and dam-release schedule transparency, align marine litter and wastewater controls, and coordinate fisheries management and blue-tourism standards, so that risk reduction and ecological quality improve together.

2.4 Methodology and Analysis

2.4.1 Overall Approach

This chapter applies a structured, indicator-based method aligned with the TDA framework, combining (i) secondary data review, (ii) construction of national and coastal-province indicators, (iii) trend and disparity analysis, and (iv) risk screening across exposure, sensitivity, and adaptive capacity. Unless noted, analysis covers Cambodia and the four coastal provinces (Preah Sihanouk, Kampot, Kep, Koh Kong) aggregated as the "coastal region." A full indicator list (definitions, units, sources, computation notes) is provided in the Annex Tables.

2.4.2 Spatial and temporal frame

Provincial boundaries follow the 1998, 2008, and 2019 census geographies. “Coastal total” is the sum of the four provinces; national values use official NIS and World Bank aggregates. Key time windows are: demography/settlement (1998–2019, extended to 2024/25 where projections exist); macro-economy/sector structure (1995–2024, or nearest span); human development/poverty (1990–2023 for HDI/IHDI, latest year for SHDI, MPI, IDPoor); and disaster/risk (2000–2024, harmonized to a consistent event/loss classification).

2.4.3 Data compilation and sources

Data were compiled using the same approach as other chapters, drawing on official and international datasets and checking consistency (details in the Annex). Main sources include: censuses and UN WUP (demography/settlement); UNDP HDR, Global Data Lab, World Bank, IDPoor, MPI 2024 (human development/poverty); WDI and macro datasets plus blue-economy diagnostics (economic structure); labour-force surveys and MoP/MEF/partner reports (livelihoods/social protection); EM-DAT, national disaster statistics, WB Climate Portal and national hydro-meteorological services (hazards/climate); and MoE/FiA/PEMSEA assessments (coastal exposure and ecosystems). Where multiple series exist (e.g., GDP, poverty, disaster losses), a primary series is used with others for triangulation or gap-filling; full citations are in Chapter 2 references, with indicator–source–year pairs listed in the Annex.

2.4.4 Indicator construction and computation

Indicators were selected for relevance to coastal vulnerability, data quality, time-series coverage, and consistency with TDA indicator sets, and grouped into: (i) exposure and development (population, density, urbanization, coastal shares, HDI/IHDI/SHDI and IHDI “penalty,” coastal–national contrasts); (ii) economic structure and livelihoods (GDP per capita, sector shares, available tourism/port measures, poverty headcounts, employment structure and dependence proxies); and (iii) risk, sensitivity and adaptive capacity (disaster frequency/impacts and proxies such as social protection, education/health access, ecosystem buffers, and basic infrastructure). Annex Tables document units, coverage, time spans, sources, and transformations; composite metrics use normalized exposure–sensitivity–adaptive capacity measures with weights and thresholds documented in the Annex.

2.4.5 Quality assurance, triangulation and limitations

Quality assurance included cross-source checks for key indicators, internal consistency tests (census totals, derived rates, coastal vs national sums), outlier review for reporting/method breaks, and transparent documentation of assumptions in Annex Tables and main-text footnotes where interpretation is affected. Limitations include uneven subnational coverage, breaks from methodological revisions (poverty lines, GDP base years, survey tools), under-counting of informal workers/migrants/seasonal labour, and ecosystem/climate indicators drawn from studies with differing methods—adequate for broad profiling but not fine-scale planning.

3. Pollution

3.1. Key Findings, Key Pollution Concerns, and Significance in National and Regional Contexts

- **Land-based sources dominate pollution.** Over 80–90% of pollutants in Cambodia's coastal waters come from land-based activities (untreated wastewater, agriculture, aquaculture, solid waste, industrial zones), causing severe degradation in estuaries and nearshore areas.
- **Nutrient and microbial pollution frequently exceed standards.** Estuaries show nitrate 2.4–2.6 mg/L and phosphate 0.7–0.8 mg/L (above ASEAN limits), while fecal coliforms often exceed 10^5 CFU/100 ml.
- **Nearshore water quality is deteriorating fastest.** Offshore waters remain moderate, but nearshore hotspots show BOD 20–60 mg/L, COD >80 mg/L, TSS 80–120 mg/L and repeated exceedances of oil, grease, and microbial indicators.
- **Agriculture and aquaculture are major nutrient sources.** Fertilizer use is 4–5 times higher than in the early 2000s; pesticides rose from 445 t (2000) to >19,000 t (2023). Marine aquaculture (~17,500 t/year) loses 25–30% of feed as waste.
- **Solid waste and plastics are escalating threats.** Coastal areas generate >590 t/day of MSW, with only 50–72% collected. National plastic waste exceeds 730,000 t/year, coastal leakage >14,000 t/year, and sediments contain 120–350 microplastic particles/kg.
- **Industrial and port activities create toxic hotspots.** About 60% of inspected facilities near ports/SEZs are non-compliant, with high oil & grease, TPH, Pb and Zn; sediment metal levels (e.g. Zn 35–90 mg/kg, Pb 10–25 mg/kg) are rising.
- **Hazardous and medical waste remain weakly controlled.** Industrial waste (~120,000 t/year) and COVID-era medical waste (up to 20 t/day) strain limited hazardous-waste capacity (~150,000 t/year), and smaller generators are poorly monitored.
- **Pollution hotspots overlap sensitive ecosystems.** High-risk zones (Prek Toeuk Sap, Kampot Bay, Kep–Ha Tien, Koh Kong estuary, Phnom Penh confluence) coincide with mangroves, seagrass, Ramsar sites and coral reefs; coral cover near Koh Rong fell from 48% (2010) to ~32% (2023).
- **Ecosystem decline undermines fisheries, aquaculture and tourism.** Fishers report reduced catches, aquaculture faces more disease, and tourist beaches experience closures and visible pollution, with public health risks peaking in the monsoon.
- **Governance exists but enforcement and treatment are weak.** Laws and policies are in place, but inspections are limited, fines rarely applied, and only ~5% of urban wastewater is treated; coastal sewerage coverage is <20%.
- **Cumulative risks are approaching critical thresholds.** Chronic exceedances of TN, TP, FC, TSS and TPH, combined with plastics and industrial pollutants, heighten risks of hypoxia, local ecosystem collapse and long-term economic losses.

3.2 Current Status

3.2.1 Pollution sources and magnitude

3.2.1.1 Agricultural and aquaculture runoff

a) Agricultural runoff

National fertilizer use has risen steeply. Figure 3-1 show fertilizer consumption per hectare of arable land increasing from **~5–10 kg/ha in 2003–2008** to roughly **40–50 kg/ha in 2018–2021**, before dipping to **~33 kg/ha in 2022, and moved up to 51kg/ha in 2023**. Over two decades this represents about a four- to five-fold increase.

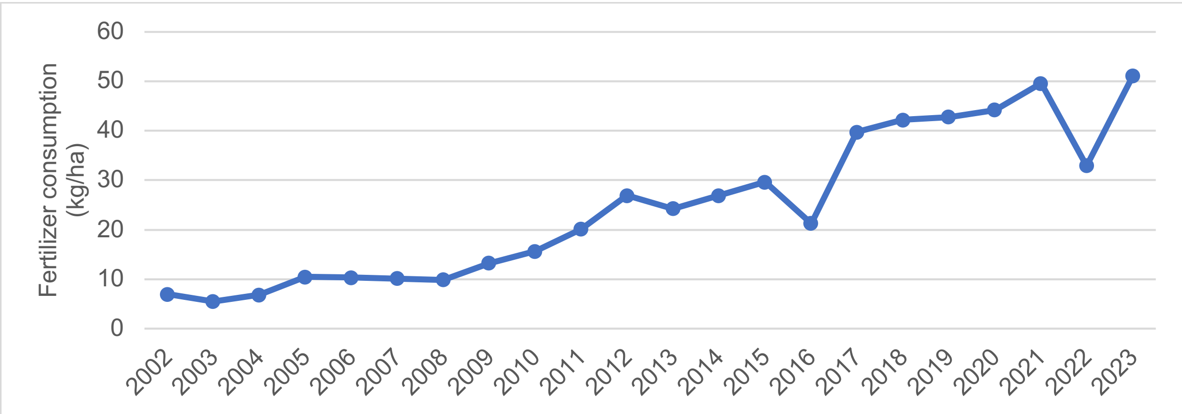

Figure 3-1 Cambodia's national fertilizer consumption (kg/ha of arable land) 2002-2023
Source: *FAOSTAT/World Bank WDI data.*

Recent national compilations indicate fertilizer intensity around **110 kg N + P_2O_5/ha/year**, broadly comparable with other regional deltas (UNEP, 2022). Monitoring in selected estuaries shows rising nutrient concentrations, with **NO_3^- increasing from about 1.8 mg/L (2015) to 2.6 mg/L (2023)** and **PO_4^{3-} from 0.45 to 0.73 mg/L**, above ASEAN guideline values (NO_3^- ≤1.0 mg/L; PO_4^{3-} ≤0.3 mg/L) in some locations (MoE, 2023).

FAOSTAT pesticide statistics (Figure 3-2) show an even stronger rise, from **445 tonnes** in 2000 to **5,330 tonnes** in 2017 and increased to over **19,000 tonnes** in 2023. Pesticide use per unit cropland increased from **~0.12 kg/ha** in 2000 to **0.6–1.1 kg/ha** in 2012–2016 and **2.7–4.2 kg/ha** in 2019–2023 (FAOSTAT RP).

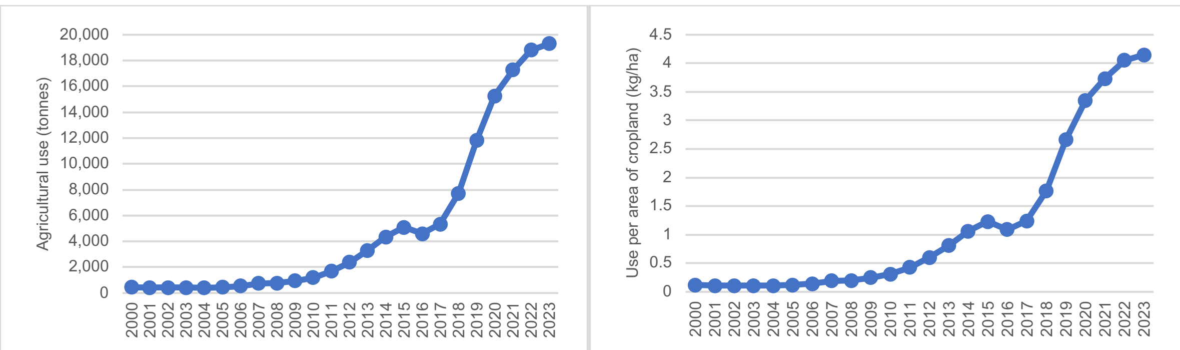

Figure 3-2 Cambodia's national pesticide use (agricultural use & use per area of cropland)
Source: *FAOSTAT, 2023.*

b) Aquaculture runoff

Cambodia's aquaculture sector continues to grow, with **1,934 ha of aquaculture holdings** reported nationally in 2022 (NIS, 2022). Earlier data show the four coastal provinces held **≈1,803 ha** of ponds, pens and cages in 2014 (Kunthy et al., 2021). National aquaculture production reached **≈330,600 tonnes in 2022**, with marine/coastal systems contributing **~5.3%**, or about **17,500 tonnes/year** (WorldFish, 2022; FAO WAPI, 2021). Marine cage farms typically have **FCR 1.6–2.0**, with **25–30% of feed lost as waste** (UNEP, 2022), elevating BOD and TSS in dense farming areas such as Trapeang Ropov and Chroy Svay. Low-value fish made up **60–100% of feed** in 2014, with pellets <1%, increasing organic loads and pressure on wild stocks (Kunthy et al., 2021). Wastewater studies also detect **antibiotic-resistance genes**, indicating antimicrobial use and emerging AMR risks (Pheakdey, C. et al., 2022).

3.2.1.2 Pollution from Major Rivers

Riverine pollution is a major driver of coastal water-quality decline because the Mekong–Tonle Sap–Bassac (MTB) system delivers large loads of nutrients, sediments, organics and microbes to Cambodia's coast and the Vietnamese delta. While the Mekong mainstream is relatively clean due to its high discharge (~14,500 m³/s) with low BOD (1–6 mg/L) and moderate TSS (~85 mg/L) (MRC 2020–2021), microbial contamination remains chronic—**100%** of fecal-coliform samples at Phnom Penh Port exceeded the **1,000 CFU/100 mL** standard in 2021.

Phnom Penh's **Trabek and Tumpun canals** are the largest pollution sources, with **BOD 100–250 mg/L**, **TSS 300–600 mg/L**, **TN up to 8.1 mg/L**, and **TP up to 6.7 mg/L** (JICA; MoE), far above national limits. The Bassac River also carries high loads (**TSS up to 2,030 mg/L; TP ~6 mg/L**) reflecting urban and peri-urban runoff. At **Chroy Changva**, where the Mekong and Tonle Sap systems converge, national datasets show repeated **TN (2018–2019)** and **TP (2012–2019)** exceedances (MoE/WEPA 2023), confirming a persistent nutrient hotspot affecting downstream loads to Viet Nam. The Tonle Sap system shows moderate but significant nutrient levels (TN ~0.9–1.15 mg/L; TP ~0.25–0.32 mg/L), contributing to seasonal eutrophication risks. The **Bassac River at Koh Khel**—the final point before the Viet Nam border—provides key data for estimating transboundary nutrient and microbial export.

Table 3-1 Hydrology and pollution indicators of major rivers – (Cambodia segment)

River Name	River Length (km)	Catchment Area	Annual Discharge	BOD (mg/L)	TSS (mg/L)	Total N (mg/L)	Total P (mg/L)	Total Coliform
Mekong River (Cambodia segment)	~500 km	~795,000 km² (entire basin)	~14,500 m³/s (mean discharge at Phnom Penh)	~1–6.2 mg/L	~85 mg/L	N/A (typically low)	N/A	~3,190 MPN/100 mL
Tonle Sap River & Tonle Sap Lake system	~147 km	~87,940 km²	*No fixed annual discharge due to flow reversal*; seasonal reverse-flow ≈ **30 km³/year**	5.0–6.4 mg/L	11–14 mg/L	0.9–1.15 mg/L	0.25–0.32 mg/L	N/A
Bassac River (Tonle Bassac)	~190 km	~3,568 km²	~10,314 m³/s	6–8 mg/L	300–2,030 mg/L	~40 mg/L	~6 mg/L	~1,000 MPN/100 mL

Source: *MoE/WEPA, 2023; MRC, 2020-2022, JICA, 2010-2013.*

3.2.1.3 Marine and Coastal Water Quality

Offshore waters generally remain in moderate condition, with **DO ~5 mg/L**, **TN 0.2–1.0 mg/L**, and **TP 0.02–0.09 mg/L**, indicating slightly nutrient-enriched but non-hypoxic conditions (MoE/PEMSEA, 2018). In contrast, nearshore estuaries show strong deterioration: **NO_3^- has risen to 2.0–2.6 mg/L** and **PO_4^{3-} to 0.7–0.8 mg/L**, exceeding ASEAN thresholds and reflecting growing inputs from agriculture, aquaculture and untreated wastewater (MoE 2023). TSS remains low offshore (1–15 mg/L) but can exceed **250–320 mg/L** in monsoon-affected estuaries such as Kampot Bay.

Microbial contamination is widespread. Monitoring reports **4,300 MPN/100 mL** in Kep (ADB 2022) and **>10^5 CFU/100 mL** near Prek Toeuk Sap and Ream in Sihanoukville (MoE 2023), driven by sewage and tourism discharges. Hydrocarbon pollution near Sihanoukville Port is persistent, with **TPH ~0.7 mg/L** and **oil & grease ~12 mg/L**, both above national limits.Harmful algal blooms are occasional; two events were reported in Kep in 2016, though no major recent events are documented. While Cambodia has no confirmed persistent hypoxic zones, several semi-enclosed inlets (e.g., Kampot estuary, Trapeang Ropov) show seasonal low DO and recurring eutrophication signals (MoE 2023).

3.2.1.4 Domestic and industrial wastewater

In 2019–2023, combined design capacity of major urban WWTPs (Phnom Penh, Preah Sihanouk, Siem Reap, Battambang) was about **35,000–40,000 m^3/day** (≈11–13 million m^3/year), while estimated urban wastewater generation is several times higher (JICA, 2015; WEPA, 2023). Nationally, centralized plants were estimated to treat only **around 5% of urban wastewater** in 2019, with the remainder managed by septic tanks, on-site systems or discharged untreated (WEPA, 2023; Metawater, 2024).

In the coastal provinces, sewerage coverage is especially low. Recent project information indicates operating WWTPs in **Preah Sihanouk (≈32,400 m^3/day)** and smaller plants in **Kampot and Kep**, but less than **20%** of sewage in key coastal towns is captured and treated (ADB, 2022; MoE, 2023). Household surveys suggest that **fewer than 10%** of households in coastal cities are connected to any urbanization system, with most relying on septic tanks that often overflow to drains and canals during the rainy season. MoE monitoring in 2023 recorded **BOD 20–50 mg/L**, **NH_3-N 1–5 mg/L**, **TSS 80–120 mg/L** and **faecal coliforms 10^4–10^5 CFU/100 mL** in urban canals of Sihanoukville and Kampot—above national effluent and ambient standards under the Sub-Decree on Water Pollution Control (1999).

3.2.1.5 Industrial and port-related wastewater

Industrial zones and port areas are important urbanized sources of wastewater and chemical pollution. At **Sihanoukville Port SEZ**, a central WWTP with design capacity **1,500 m^3/day** serves factories in the zone (JICA, 2024/25). Municipal WWTPs now under construction or commissioning in Preah Sihanouk (total planned **12,000 m^3/day**) will also receive mixed domestic-industrial flows (UNIDO, “Bridge for Cities”).

Monitoring of drainage channels in Phnom Penh (Trabek and Tumpun) shows consistently elevated pollutant levels during 2010–2013, with **BOD 100–250 mg/L**, **COD 200–380 mg/L**, **TSS 300–600 mg/L**, **T-N up to 8.1 mg/L**, **T-P up to 6.7 mg/L**, and nutrients and Cr^{6+} frequently exceeding standards (JICA, 2016; DPWT/JICA, 2019). Inspections in the Sihanoukville-port area in 2023 reported non-compliance with effluent standards in around **60%** of inspected facilities. Sample results near the port showed **oil and grease ≈12 mg/L**, **TPH ≈0.7 mg/L**, **Pb ≈0.25 mg/L** and **Zn ≈1.1 mg/L**, all at or above national limits. Coastal sediments near Prek Toeuk Sap and Stung Hav Bay contain elevated metals, with Zn **35–90**

mg/kg, Pb **10–25 mg/kg** and Cu **12–28 mg/kg** (MoE, 2023). The POSEZ industrial estate in Banteay Meanchey has a WWTP designed for **19,000 m³/day**, illustrating the scale of industrial flows nationally (JICA, 2016; Cambodia Chamber of Investment).

3.2.1.6 Solid waste and plastic leakage

Municipal solid waste (MSW) in Cambodia is rising with urbanization and tourism. National MSW reached **≈4.8 million t/year in 2020**, with **0.78 kg/cap/day** in urban areas (Pheakdey et al., 2022). Phnom Penh generates the highest volumes, with per-capita rates declining from **1.32 kg/day (2016)** to **0.98 kg/day (2022)** (UNEP/PPCA, 2018; PPSWMA, 2023). Waste-composition studies show **50–60% organic** and **~20% plastics**; national 3R assessments report **63–80% organic** and **3–16% plastics/rubber/leather** across cities (UNCRD, 2017; MoE, 2023).

Coastal provinces contribute substantial waste: **450–500 tonnes/day** in Preah Sihanouk, **170–200 tonnes/day** in Kampot, **45–55 tonnes/day** in Kep, **≈20 tonnes/day** in Koh Kong town, and **≈2 tonnes/day** on Koh Sdech (Khmer Times, 2021–2023; CamboJA, 2022; UN-Habitat, 2025). Collection efficiency is often **<70%**, with uncollected waste commonly open-dumped or burned near waterways. Cambodia had **~164 dumpsites** in 2020—mostly open dumps lacking liners or leachate control (Pheakdey et al., 2022; ODC, 2023).

Plastic waste is significant: **~730,000 t/year** nationally (RGC/UNEP, 2021). Phnom Penh alone generates **≈0.205 kg/cap/day** of plastics, or **≈262,800 t/year**, assuming ~20% plastic in total waste (PPWMS 2018; UNDP, 2022). Coastal beach and sediment surveys (Otres, Ream, Koh Rong Sanloem) consistently find plastic bags, wrappers and bottles dominating debris, with microplastic levels in sediments reaching **hundreds of items/kg.**

3.2.1.7 Hazardous waste

Data on hazardous waste remain incomplete, but available sources show rising medical and industrial streams. Pre-COVID estimates put Phnom Penh's medical waste at **~40 t/month (~480 t/year)** (GIZ, 2020), surging during COVID-19 to **up to 20 t/day (~7,300 t/year)** (UNDP, 2021). Industrial waste is substantial: a 2021 Korean study estimated **~120,000 t/year** of collected industrial waste, a mixed stream with hazardous components including chemical sludges, metal-bearing wastes, oils, solvents, acids/alkalis and contaminated packaging (KSP, 2021; BSfD, 2023).

Treatment capacity has expanded via the **Chip Mong Ecocycle** co-processing facility in Kampot, with **~150,000 t/year** cement-kiln capacity and **~1,100 t** of hazardous-waste storage (UNCRD, 2023; BSfD, 2023). For medical waste, Cambodia operated **~34 incinerators in 2022**, including five new JICA-supported units.

3.2.1.8 Oil pollution

The most recent documented incident is the **February 2025 oiling at Prek Treng Beach (Preah Sihanouk)**, where an estimated **~2,000 litres** leaked and **≈95%** was cleaned within days (Kiripost; Khmer Times; Cambodianess, 2025). Cambodia has **no consolidated national spill time-series**. The two main international ports—**PAS** (Sihanoukville) and **PPAP** (Phnom Penh)—have reception facilities or contractors for oily waste and bilge water, though annual treatment volumes are not publicly reported (IMO MEPSEAS; JICA). Information on oily-waste handling at **smaller ports, fishing harbors and repair yards** remains limited.

3.2.1.9 Atmospheric pollution

Cambodia's national GHG inventory reports **SO_2 emissions of 32.61 kt** and **NO_x (as NO_2) of 43.43 kt** in 2016, and **territorial CO_2 emissions of about 17,620 kt** in 2022 (UNFCCC, 2019; BUR3). Cambodia participates in the **EANET** acid-deposition network with an urban wet-deposition monitoring site in Phnom Penh. Regional assessments suggest typical urban wet deposition of **>10–30 kg S/ha/year** and **~5 kg N/ha/year** at many East and Southeast Asian sites (EANET PRSAD4, 2022; MICS-Asia III, 2020).

3.2.2 Pollution hotspots and sensitive areas

Monitoring across riverine and coastal stations shows recurring pollution hotspots where BOD, nutrients, solids and microbial indicators exceed standards. At the Mekong–Tonle Sap confluence (CPP), **100% of fecal-coliform samples** in 2021 exceeded the 1,000 CFU/100 mL limit despite low BOD (~1 mg/L), indicating severe microbial loading (MRC 2020–2021). Chroy Changva recorded **TN exceedances (2018–2019)** and repeated **TP exceedance (2012–2019)**, while CTK–Takhmao remains a nutrient hotspot linked to urban expansion. Phnom Penh tributaries Trabek and Tumpun show **extreme pollution** (BOD 100–250 mg/L; TSS 300–600 mg/L; high TN/TP).

In the coastal zone, Kep exceeded **TN, TP and oil & grease** in 2018 (MoE/WEPA). Recent MoE/FIA monitoring identifies hotspots at:

- **Prek Toeuk Sap (Sihanoukville):** BOD 25–60; COD >80; FC >10^5 CFU/100 mL
- **Kampot River:** TSS 120; NO_3^- 2.4; PO_4^{3-} 0.8 mg/L; DO <4 mg/L
- **Tatai estuary:** BOD 20–35; coliform >10^4 CFU/100 mL

These exceed Cambodian coastal standards and ASEAN Class B levels. Sensitive habitats show cumulative impacts: **Peam Krasop sediments** contain **Zn 35–90 mg/kg; Pb 10–25 mg/kg**, and coral cover around **Koh Rong/Sanloem** has declined from ~48% (2010) to ~32% (2023), with strongest impacts near discharge zones.

3.3. Discussion and Conclusions

3.3.1 Priority Transboundary Pollution Issues

3.3.1.1 Mekong–Tonle Sap–Bassac System: Nutrient and Microbial Loads

The MTB system is the primary transboundary pollution route from Cambodia to Viet Nam. At Phnom Penh's CPP station, **fecal coliform exceeded standards in 100% of 2021 samples** (MRC, 2021), reflecting chronic untreated wastewater discharge. Long-term TN and TP exceedances at Chroy Changva (2012–2019) (MoE/WEPA, 2023) and highly polluted tributaries—e.g., Trabek and Tumpun canals with **BOD 100–250 mg/L**, **TP up to 6.7 mg/L**, **TSS up to 600 mg/L**—demonstrate sustained nutrient and microbial loading.

Given Phnom Penh's position mid-system, pollutants reach the Vietnamese Mekong Delta within days to weeks, contributing to algal blooms, fish kills, and microbial contamination recorded in the Bassac and Hau Rivers. Upstream FC and solids have been linked to disease outbreaks in Viet Nam's Pangasius farms, with implications for export quality. The Cambodia–Viet Nam Joint Commission has repeatedly emphasized improved wastewater control in Phnom Penh due to its direct effects on delta aquaculture, food safety, and estuarine productivity.

3.3.1.2 Gulf of Thailand Circulation: Marine Litter and Microplastics

Cambodia's coastal provinces leak an estimated **14,400 tons of plastic annually** due to low waste-collection rates (50–68%), open dumping, and burning (MoE, 2024; ADB, 2022). Nearshore sediments already contain **120–350 microplastic particles/kg** (FiA & UNDP 2023), indicating widespread fragmentation and dispersion.

UNEP circulation modelling (2022) shows that plastics from Sihanoukville and Kampot drift toward **Gulf of Thailand's** central convergence zone before returning seasonally to Cambodian waters. Without coordinated monitoring and cleanup, the Gulf may become a regional microplastic hotspot by 2030.

3.3.1.3 Aquaculture-Driven Nutrient and Organic Pollution

Marine aquaculture accounts for only **5–6%** of Cambodia's aquaculture output (~17,000 t/yr) but causes concentrated nutrient and organic loading in shared embayments. Inefficient FCRs (**1.6–2.0**) release **600–1,000 kg** of uneaten feed and waste per tonne of fish, with **25–30%** of feed becoming direct nutrient discharge (UNEP, 2022).

Coastal monitoring shows **TN 0.2–1.0 mg/L** and **TP 0.02–0.09 mg/L** (PEMSEA&MoE, 2018), with elevated values near farms in Kampot, Kep, and Koh Kong—consistent with early eutrophication. In shared estuaries such as **Koh Kong–Trat** and **Kep–Ha Tien**, nutrient enrichment alters plankton communities, reduces juvenile fish survival, and disrupts recruitment of migratory species (anchovies, mackerel, shrimp) exploited by Cambodia, Thailand, and Viet Nam.

3.3.1.4 Hazardous and Industrial Waste: Hydrocarbon and Heavy-Metal Risks

Industrial expansion in Sihanoukville has increased hydrocarbon and metal contamination with cross-border implications. In 2023, waters contained **TPH 0.7 mg/L**, **oil and grease 12 mg/L**, and elevated **Pb (0.25 mg/L)** and **Zn (1.1 mg/L)**—all above national limits (MoE,2023). Sediment records in Peam Krasop and Stung Hav show chronic accumulation (**Zn 35–90 mg/kg**, **Pb 10–25 mg/kg**) linked to industrial effluent, ship repair, and port runoff.

Given Sihanoukville's location on major regional shipping routes, oily waste and spills can reach Thai and Vietnamese waters within days. The **2025 Prek Treng spill (~2,000 L)** highlighted weak surveillance and response capacity. Limited port-reception facilities, incomplete MARPOL enforcement, and the absence of a spill inventory heighten risks of illegal at-sea discharges, contributing to regional hydrocarbon contamination.

3.3.2 Interactions: Impacts on Environment and Society

3.3.2.1 Environmental Interactions

Eutrophication, hypoxia, and ecosystem shifts: Rising nutrient inputs from untreated wastewater, fertilizers, and aquaculture waste are driving eutrophication in estuaries such as Kampot Bay, Prek Toeuk Sap, and the Tatai River. Monitoring shows **NO_3^- up to 2.4 mg/L**, **PO_4^{3-} up to 0.8 mg/L**, and **DO <4 mg/L** (MoE 2023; FiA 2024)—all above national and ASEAN thresholds and consistent with early hypoxia. These conditions trigger dense phytoplankton growth, reduced light penetration to seagrass, and higher risk of harmful algal blooms. Resulting ecosystem shifts favour opportunistic, pollution-tolerant species, reflected in coral declines in Kampot and Kep (**48% → 32%**, 2010–2023; FiA & UNDP 2022).

Habitat degradation from sedimentation, plastics, and suspended solids: High **TSS (80–120 mg/L)**, chronic sedimentation, and **>14,000 t/year** of plastic leakage are smothering mangroves, seagrass, and corals. Sediments contain **120–350 microplastic particles/kg**, indicating accelerating fragmentation (FiA & UNDP 2023). Mangrove cores from Peam Krasop show rising heavy metals (**Zn 35–90 mg/kg; Pb 10–25 mg/kg**), while seagrass beds in Kampot exhibit shorter leaves and heavier epiphyte loads linked to nutrient and sediment stress. Coral reefs around Koh Rong show localized mortality and reduced recruitment near discharge zones.

Toxicity and food-web contamination: Industrial effluents containing **Pb, Zn, Cu**, and hydrocarbons affect reproduction and early-life stages of fish, crustaceans, and mollusks. Elevated metals in sediments near Stung Hav and Prek Toeuk Sap increase risks of bioaccumulation in commercial species. Hydrocarbon contamination (**TPH 0.7 mg/L**) is associated with impaired gill function, higher disease susceptibility, and reduced spawning success. Because many affected species migrate across the Gulf of Thailand, toxicity and contamination have **cross-border implications** for recruitment and regional fish-stock dynamics.

3.3.2.2 Social and Economic Interactions

Public health risks from microbial and chemical contamination: Extremely high fecal-coliform levels (**>10^5 CFU/100 mL**) in coastal bathing waters and fish-landing sites (MoE 2023) pose immediate health risks, with seasonal spikes in gastrointestinal illness reported in Kampot and Sihanoukville during monsoon periods when runoff and sewage overflow intensify. Chemical risks also arise where heavy metals and hydrocarbons contaminate nearshore waters, exposing low-income, fish-dependent households—especially shellfish consumers—to chronic toxicity.

Impacts on fisheries livelihoods and food security: Pollution reduces fishery productivity through hypoxia, habitat degradation, contamination, and higher disease prevalence in both wild and cultured fish. Small-scale fishers in Kampot and Kep report declining catches and longer travel distances to viable grounds. Aquaculture farmers face higher mortality, greater antibiotic use, and reduced profitability—contributing to emerging antimicrobial resistance (AMR) documented in Cambodian marine aquaculture (IJERPH, 2020). These stresses undermine household food security and erode seafood market competitiveness.

Tourism and coastal-economy degradation: Tourism—one of Cambodia's fastest-growing coastal sectors—is highly sensitive to pollution. Sewage-driven beach closures in Sihanoukville, visible algal blooms, plastic accumulation, and the **2025 Prek Treng oiling incident** have triggered booking cancellations in Koh Rong and Kampot Bay. Environmental decline increasingly deters investors, while reduced tourism revenue further weakens municipal budgets for waste and wastewater management, creating a reinforcing cycle of degradation.

Loss of ecosystem services: Pollution-driven degradation of mangroves, seagrass and coral reefs reduces key ecosystem services: nursery habitat productivity, blue-carbon storage, storm-buffering capacity, and sediment trapping function. These losses increase erosion and coastal vulnerability while undermining long-term climate-adaptation capacity.

3.3.3 Risk Assessment

3.3.3.1 Nutrient Enrichment & Eutrophication

Nutrient loading from agriculture, aquaculture and untreated wastewater represents a **very high-likelihood** systemic risk. Fertilizer use has increased 4–5× since the early 2000s, pesticide inputs exceed **19,000 t/yr**, and coastal provinces release **>21 million m³** of untreated wastewater annually (WDI; FAOSTAT; MoE, 2023). In Kampot Bay, Kep and

Sihanoukville, **NO_3^- 2.4–2.6 mg/L** and **PO_4^{3-} 0.73–0.8 mg/L** exceed ASEAN thresholds, generating **RQ=2–3** and consistent eutrophication symptoms: hypoxia (DO <4 mg/L), recurrent algal blooms, coral decline (**48% to 32%**, 2010–2023), and high TSS (**120–320 mg/L**). Low-flushing sites—Trapeang Ropov, Peam Krasop, Kampot estuary—are especially sensitive, and Gulf-wide circulation gives this risk **high transboundary significance**, affecting shared fisheries and coastal water quality.

3.3.3.2 Microbial Contamination & Public-Health Risk

Microbial contamination is an acute health and environmental risk, with exceedances recorded across riverine and coastal sites. Phnom Penh Port showed **100% FC exceedance** in 2021 (MRC); Sihanoukville canals regularly exceed **10^5 CFU/100 mL**; and Kep recorded **4,300 MPN/100 mL** in 2022 (RQ=4.3). With sewerage coverage below **14%** in coastal provinces, the likelihood of persistent contamination is **very high**, contributing to disease outbreaks, unsafe shellfish harvests, and tourism risks. WQI screening classifies hotspots such as Prek Toeuk Sap, Tumpun Canal and Kampot River mouth as **"poor–very poor"**, requiring urgent wastewater and sanitation interventions. Because microbial loads move through the Mekong–Bassac system and nearshore currents, this risk holds **moderate–high transboundary relevance**.

3.3.3.3 Solid Waste Leakage & Microplastics

Solid waste leakage is a chronic and expanding pressure. Coastal provinces generate **~590 t/day**, with only **50–72%** collection efficiency—resulting in **>14,000 t/year** of plastic leakage (ADB 2022; MoE 2024). Microplastics reach **120–350 particles/kg** in sediments near beaches and ports (FiA & UNDP 2023). The likelihood of ongoing leakage is **high**, driven by unengineered landfills, rainfall, tourism and riverine transport. Impacts include ingestion/entanglement of marine fauna, seagrass and mangrove damage, visual pollution and accumulation in food webs. Gulf circulation transports plastics across borders, giving this category **very high transboundary significance** and **RQ=2–6** relative to regional baseline densities.

3.3.3.4 Industrial & Port-Related Contaminants

Industrial and port-related pollution shows widespread non-compliance as the industrial effluent monitoring shows routine violations of Cambodia's Sub-Decree on Water Pollution Control, as shown in the Table 3-1 below:

Table 3-2 Compliance assessment of key pollution indicators using RQ

Parameter	Observed	Standard	RQ	Compliance Status
Overall facility compliance	60% of inspected facilities **non-compliant**	—	---	**Non-compliant**
Oil & Grease	12 mg/L	5 mg/L	**2.4**	Exceeds limit
TPH	0.7 mg/L	0.5 mg/L	**1.4**	Exceeds limit
Pb	0.25 mg/L	0.1 mg/L	**2.5**	Exceeds limit
Zn	1.1 mg/L	1.0 mg/L	**1.1**	Slightly exceeds limit

Source: MoE, 2023.

Sediments in Sihanoukville, Peam Krasop and Koh Kong show elevated **Zn (35–90 mg/kg)**, **Pb (10–25 mg/kg)** and **Cu (12–28 mg/kg)**—above pre-2000 baselines. Likelihood is **moderate–high** near ports, SEZs and industrial corridors, with hotspots at PAS, Stung Hav, Prek Toeuk Sap and Tumpun–Trabek. Impacts include chronic toxicity, metal bioaccumulation in fish and constraints on aquaculture. Sediment transport along the coast creates **moderate** transboundary risk, especially toward the Cambodian–Thai shelf.

3.3.3.5. Oil Spills & Hydrocarbon Pollution

Oil pollution is episodic but potentially severe. The **2025 Prek Treng spill (~2,000 L)** highlighted vulnerability of beaches and port-adjacent habitats. Chronic low-level releases from bilge water and ship repair are suspected though not well quantified. Likelihood of major spills is **low–moderate**, but consequences are **high**, including smothering of coral and seagrass, fish mortality and tourism disruption. Strong currents mean even moderate spills can drift regionally, giving this category **high transboundary significance**.

3.3.3.6 Hazardous Waste Mismanagement

Hazardous waste management remains limited, with estimates of **~120,000 t/year** of industrial waste potentially containing hazardous fractions (KSP 2021). COVID-19 surges generated **up to 20 t/day** of medical waste (UNDP 2021). With only one co-processing facility and weak tracking systems, the likelihood of improper disposal is **moderate**, with risks of soil/groundwater contamination and toxic residues entering rivers and estuaries. Transboundary significance is **moderate**, mainly through Mekong–Bassac runoff pathways.

3.3.3.7 Cumulative and Systemic Risk

a) Key cumulative risk and impacts

Cambodia's greatest pollution risk arises from **multiple pollutants interacting simultaneously**—nutrients, microbes, plastics, hydrocarbons and metals—pushing ecosystems toward ecological thresholds. Documented cumulative impacts include:

- Persistent hypoxia in sheltered bays (Kampot Bay, Trapeang Ropov).
- Coral and seagrass decline (**48% → 32% coral cover**, 2010–2023).
- Long-term reductions in fisheries productivity and juvenile habitats.
- Emerging **antimicrobial resistance (AMR)** in aquaculture environments.
- Major tourism and public-health incidents driven by fecal contamination and algal blooms.
- Regional ecosystem degradation as pollutants circulate across the Gulf of Thailand.

b) High-Risk Geographic Hotspots

Table 3-3 below present the summary of the high-risk geographic hotspots.

Table 3-3 Summary of the high-risk pollution hotspots in Cambodia (Based on RQ, WQI, and Pollutant Exceedances)

Hotspot	Description	Key Indicators
Prek Toeuk Sap – Sihanoukville	Multi-pollutant hotspot with organics, hydrocarbons, microbes	BOD 25–60 mg/L; COD >80 mg/L; TPH RQ=1.4; FC >10^5 CFU/100 mL
Kampot River Estuary & Kampot Bay	High nutrients and sediment loads from agriculture/aquaculture	NO_3^- ≈2.4 mg/L; PO_4^{3-} ≈0.8 mg/L; TSS ≈120 mg/L; DO <4 mg/L
Kep Coast – Ha Tien	Eutrophication-prone transboundary zone	HABs (2016); nutrient exceedances; degraded WQI
Tatai – Koh Kong Estuary	Exposed to mining runoff, domestic wastewater, monsoon sediment	Elevated TSS, metals (local studies)

Phnom Penh Confluence Zone	Severe nutrient/microbial pollution feeding Mekong–Bassac	FC 100% exceedance; TN/TP above standards

Source: MoE (2023), MRC (2021–2022), JICA (2016), WEPA (2023), PEMSEA (2018)

c) Populations Most at Risk

Groups facing disproportionate exposure include:

- Households located along estuaries and canals vulnerable to contaminated water and flooding.
- Communities dependent on seafood, gleaning and nearshore fisheries affected by pathogens, microplastics and metals.
- Tourism-reliant populations in Kep, Koh Rong, Otres and Prek Treng.
- Small-scale aquaculture farmers exposed to disease outbreaks and AMR.
- Children, elderly and immunocompromised people highly sensitive to microbial and chemical hazards.

3.3.4. Interactions: Current Management and Institutions

3.3.4.1 Law and Policy

Cambodia's pollution management framework is now anchored in the **Code on Environment and Natural Resource (2023)**, which consolidates earlier provisions and mandates environmental impact assessment, permitting and pollution control. This is operationalised through key sub-decrees on **Water Pollution Control (No. 27/1999)** and **Solid Waste Management (No. 113/2015)**, which define discharge standards, licensing requirements and basic obligations for waste generators. More recent policies—the **National Policy on Waste Management (2018)**, the **National Action Plan for Marine Plastic Waste Management 2023–2030**, and the **Integrated Coastal Management (ICM) Strategy 2022–2030**—extend this framework to municipal waste, marine litter and integrated coastal planning, with coordination mandated to the **National Committee for Coastal Management and Development (NCCMD)** (NCCMD 2022).

3.3.4.2 Institutions

Pollution monitoring and enforcement are led by the **Ministry of Environment (MoE)** through its Department of Pollution Control and the **Coastal Water Quality Monitoring Network**, with technical support from the **Fisheries Administration (FiA)**, provincial departments and local universities. MoE's **Department of Pollution Control** and its **Coastal Water Quality Monitoring Network** lead national monitoring and compliance inspections. Routine coastal monitoring has been in place since about **2016** at roughly **12 stations** across the four coastal provinces, complemented by river monitoring at stations such as CPP, CTK and Chroy Changva. Core parameters include pH, DO, BOD, COD, NH_3-N, NO_3^-, PO_4^{3-}, oil and grease, and coliform bacteria (MoE 2023).

FiA plays a critical role in addressing aquaculture effluent and coastal habitat degradation, but regulatory reach remains constrained. Cage aquaculture continues to expand in Kampot, Kep, and Koh Kong without routine nutrient discharge monitoring, contributing to eutrophication risks in transboundary estuaries such as **Ha Tien–Kep** and **Koh Kong–Trat**. MPWT oversees ports and navigational safety, including port-reception facilities (PRFs) at PAS and PPAP.

3.3.4.3 Regional and Global Cooperation

Regionally and globally, Cambodia has begun to align its domestic efforts with broader initiatives. It is a participant in the **COBSEA Regional Action Plan on Marine Litter (2021)** and the **ASEAN Framework of Action on Marine Debris**, both of which support implementation of **UNEA resolution 5/14** on a global plastics treaty (COBSEA 2021). These mechanisms provide guidance on monitoring marine litter, developing extended-producer-responsibility (EPR) schemes and strengthening port-reception systems.

On the ground, pilot projects such as the **Sihanoukville Marine Litter Pilot (2022–2024)**—implemented by MoE with UNEP support—have tested community-based segregation, port-side waste reception and beach-cleanup models. They demonstrate that multi-stakeholder approaches (local government, tourism operators, communities) can measurably reduce beach litter and improve awareness.

3.3.5 Gaps and Priority Challenges

Monitoring, data and risk tools: Monitoring coverage remains too sparse and uneven to support reliable RQ/WQI assessments at basin or Gulf scale, and several priority pollutants are monitored irregularly—limiting trend analysis and hotspot detection (MoE, 2023; WEPA, 2023). Data remain fragmented across agencies, with no unified national database or routine, public "environmental report card" (MoE, 2023).

Enforcement and compliance: Industrial non-compliance remains high (≈60% of facilities), with repeated exceedances for BOD, TPH, Pb and Zn (MoE, 2023; UNDP, 2021). Permits and expansions continue even where WWTP performance is weak or absent, while informal dumping/open burning persist due to limited inspection coverage and penalties (MoE, 2023; Business Scouts for Development, 2020).

Infrastructure and financing: Centralized treatment covers only ~5% of urban wastewater, so most effluent is discharged untreated (JICA, 2016; GIZ, 2020). Landfills often function as open dumps, increasing leachate and plastic leakage risks, while hazardous-waste capacity remains limited and under-financed (UNCRD, 2023; MoE, 2023).

Sector integration and land/sea planning: Sector plans rarely include pollution-load or nutrient targets, and spatial planning does not consistently apply carrying-capacity or RQ thresholds when siting/expanding aquaculture, ports, or waste facilities—raising cumulative impacts in sensitive coastal zones (MoE, 2023; WEPA, 2023).

Social and equity dimensions: Canal-side communities, fishers/gleaners, and tourism workers face disproportionate exposure and livelihood impacts; public access to monitoring results and community reporting/grievance channels remains weak (MoE, 2023).

Transboundary and emerging issues: Joint monitoring with Thailand and Viet Nam for marine litter, contamination and hypoxia remains limited (WEPA, 2023). Emerging pollutants (antibiotics/AMR markers, microplastics) are not yet fully embedded in standards or routine monitoring, leaving risk blind spots (MoE, 2023; ODC, 2023).

3.3.6 Recommended Priority Actions

a) Strengthen monitoring, data systems & risk tools

Cambodia should establish a unified national pollution database that integrates MoE, FiA, MRC and JICA-linked datasets, and institutionalize routine RQ/WQI scoring to track priority hotspots. Selected stations should add pesticides, microplastics and AMR markers, and

Cambodia should launch joint monitoring with Thailand and Viet Nam for the Gulf of Thailand and shared estuaries.

b) Reduce nutrient & microbial loads

Priority investments should accelerate sanitation and WWTP coverage in Phnom Penh and coastal towns, targeting the worst canals and outfalls first. Catchment-level nutrient management (buffer strips, fertilizer budgeting and extension support) should be implemented in key agricultural areas, while aquaculture growth should be guided by discharge standards and carrying-capacity assessments for shared embayment.

c) Address solid-waste leakage & marine plastics

Coastal waste services should expand collection coverage and upgrade open dumps toward controlled landfill operations to reduce leakage and leachate. Policy instruments should complement service improvements, including EPR for plastics, deposit-return systems and targeted measures in tourism areas. Successful marine-litter pilots, including those from Sihanoukville, should be scaled nationally, alongside a Gulf of Thailand partnership harmonize monitoring and prevention actions.

d) Control industrial, port-related & hazardous pollution

Compliance should be strengthened through risk-based inspections prioritizing locations where RQ>1, and permit renewals should be tied to verified WWTP performance. PAS and PPAP should report annual oily-waste and hazardous-waste reception volumes to improve transparency. Hazardous-waste handling should be reinforced through available treatment capacity.

e) Protect hotspots & vulnerable communities

Priority hotspots should be designated as pollution-control zones with stricter limits and targeted ecosystem restoration (mangroves, seagrass and wetlands). High-exposure communities should receive practical measures such as safer water options, shellfish/seafood advisories where relevant, and livelihood support. Cambodia should also explore a regional Gulf of Thailand “blue corridor” linking key MPAs to strengthen shared protection efforts.

f) Governance & financing

Mandates should be clarified and operationalized under the 2023 Code on Environmental and Natural Projection, supported by stronger coordination and enforcement. A dedicated coastal/marine pollution fund—combining national budgets, environmental fees and blue-economy/climate finance—would sustain monitoring, infrastructure and restoration. Regional cooperation objectives (COBSEA/ASEAN/MRC) should be embedded in national plans and NDC updates.

3.4 Methodology and Analysis

3.4.1 Overall Approach

The assessment of pollution in Cambodia’s coastal and riverine systems followed a structured methodology consistent with the Transboundary Diagnostic Analysis (TDA) framework. The analysis combined **(i) secondary data review**, **(ii) indicator-based assessment**, **(iii) risk screening**, and **(iv) spatial interpretation** of pollutant pathways from land to coast and across borders.

3.4.2 Data Compilation and Validation

Data were compiled from the MoE, MRC, FiA, JICA-supported surveys, WEPA country data, ADB project reports, and peer-reviewed studies. Key data types included: **water-quality parameters** (BOD, COD, DO, nutrients, metals, coliforms); **hydrological datasets** (river discharge, seasonal flows, catchment areas); **waste and effluent statistics** (domestic, industrial, hazardous, medical); marine litter and microplastic surveys; and coastal ecosystem condition data (coral cover, seagrass density, mangrove status). Data were cross-checked across sources to address inconsistencies (e.g., differences in sampling frequency, analytical methods, or units).

3.4.3 Indicator Selection and Scoring

Indicators were selected based on relevance to pollution pathways, availability of time-series data, and alignment with: **ASEAN Marine Water Quality Guidelines**; **Cambodian Water Pollution Control Standards (1999)**; **MRC Water Quality Target Values**; and **UNEP/COBSEA Regional Marine Litter Indicators**. Each indicator was assessed using:

- **Absolute values** relative to national/regional standards
- **Temporal trends** (where multi-year data existed)
- **Spatial exceedances** at hotspot locations
- **Risk Quotients (RQ = observed / standard)**
- **Water Quality Index (WQI) categories**

3.4.4 Risk Quotient (RQ) Analysis

The RQ method was used to screen pollutant exceedances:

RQ = Measured value ÷ Guideline/Standard value

Where:

- **RQ < 1** = compliant / low risk
- **RQ 1–2** = moderate risk / localized exceedances
- **RQ > 2** = high risk
- **RQ > 3–5** = severe risk / likely ecological impact

RQ analysis was applied to nutrients (NO_3^-, NH_3-N, PO_4^{3-}), microbial indicators (MPN/CFU), hydrocarbons (TPH), heavy metals (Pb, Zn, Cu), and solids (TSS).

3.4.5 Water Quality Index (WQI) Screening

WQI categories were calculated using DO, BOD, coliforms, TSS and nutrients where data allowed. Interpretation followed:

- **80–100 = Good**
- **50–79 = Moderate**
- **25–49 = Poor**
- **<25 = Very Poor / unsuitable for direct use**

WQI supported identification of hotspots such as Prek Toeuk Sap, Kampot estuary, and Phnom Penh confluence.

3.4.6 Spatial and Transboundary Analysis

GIS analysis and documented hydrodynamic pathways were used to map: pollution hotspots; estuarine mixing zones; river-to-sea discharge routes; and Gulf of Thailand circulation patterns (e.g., plastic drift, nutrient transport). Transboundary analysis incorporated regional oceanographic models, especially for microplastics and nutrient dispersal toward Viet Nam and Thailand.

3.4.7 Limitations

Key gaps and limitations included: inconsistent monitoring frequencies between agencies; Gaps in microplastics, pesticides, antibiotics, and emerging contaminants; limited long-term time series for estuarine and coastal stations; absence of publicly available WWTP discharge data from SEZs and ports; differences in laboratory methods across datasets (MoE vs. MRC vs. JICA). These constraints were addressed through triangulation, median-value extraction, and RQ/WQI screening to support a defensible TDA-level diagnostic.

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4. Ecosystems

4.1 Key Findings

- **Mangroves** remain strategic natural infrastructure but are shrinking: from ~58,866 ha (2014) to ~55,355 ha (2025) (≈−6%; ~319 ha/year), with main losses in Koh Kong and peri-urban Preah Sihanouk.
- **Botum Sakor peat-mangroves** (~4,768 ha; peat 0.5–1.0 m, max ~1.35 m; ≥26 plant species) are a rare blue-carbon asset, requiring "hydrology-first" protection to avoid irreversible carbon loss and weaker coastal defence.
- **Peam Krasop–Koh Kapik** is one of mainland SE Asia's largest mangrove–intertidal systems and a key livelihood base; >65% of nearby households derive 70–90% of income from wetland resources, so nursery loss or salinity/channel change has immediate welfare impacts.
- **Coral reefs** are generally in "fair" condition but under cumulative pressure: Koh Rong reefs dominated by sediment-tolerant massive corals (~30% mean live cover); Kep retains high-cover pockets (e.g., Koh Seh ~64%). Overfishing, turbidity and bleaching drive structural simplification and losses for fisheries/tourism.
- **Seagrass meadows** (~11,500 ha in Kep–Kampot, plus major beds off Peam Krasop and Prey Nob/Steung Hav) are extensive but highly sensitive to trawling and turbidity—recovering where trawl controls hold, declining where dredging, shoreline works and runoff limit light.
- **Globally significant fauna** persist at low abundance: Irrawaddy dolphins (EN) in Kep, dugongs and marine turtles along the coast, fishing cat and smooth-coated otter in mangroves—all facing bycatch and habitat-fragmentation risks.
- **Three sensitivity hotspots** stand out: (i) Botum Sakor peat-mangroves; (ii) Peam Krasop–Koh Kapik connectivity complex; (iii) Kep–Kampot seagrass corridor (blue-carbon and nursery values but strong trawl/light pressures).
- **Low-cost, high-return actions** include hydrologic safeguards in peat-mangroves, anti-trawl networks and patrol fuel for CFis, targeted closures around megafauna bycatch areas, and basic wastewater controls in growth nodes to prevent major income and asset losses while enabling blue-carbon/tourism gains.
- **Transboundary stakes** are significant: reef and seagrass health affects migratory stocks and tourism across the Gulf of Thailand; aligned standards on water quality, IUU control and spill/emergency readiness with Thailand and Viet Nam can magnify benefits.
- **Management is improving but needs scaling:** the mixed MNP–MFMA–CFi/CPA model works where zoning, enforcement and monitoring are funded; priorities are harmonising MoE–FiA rules (notably Koh Rong), fast-tracking Kampot MFMA, embedding joint habitat/water-quality monitoring, and securing sustained finance (user fees, fines, blue-carbon/seagrass credits).

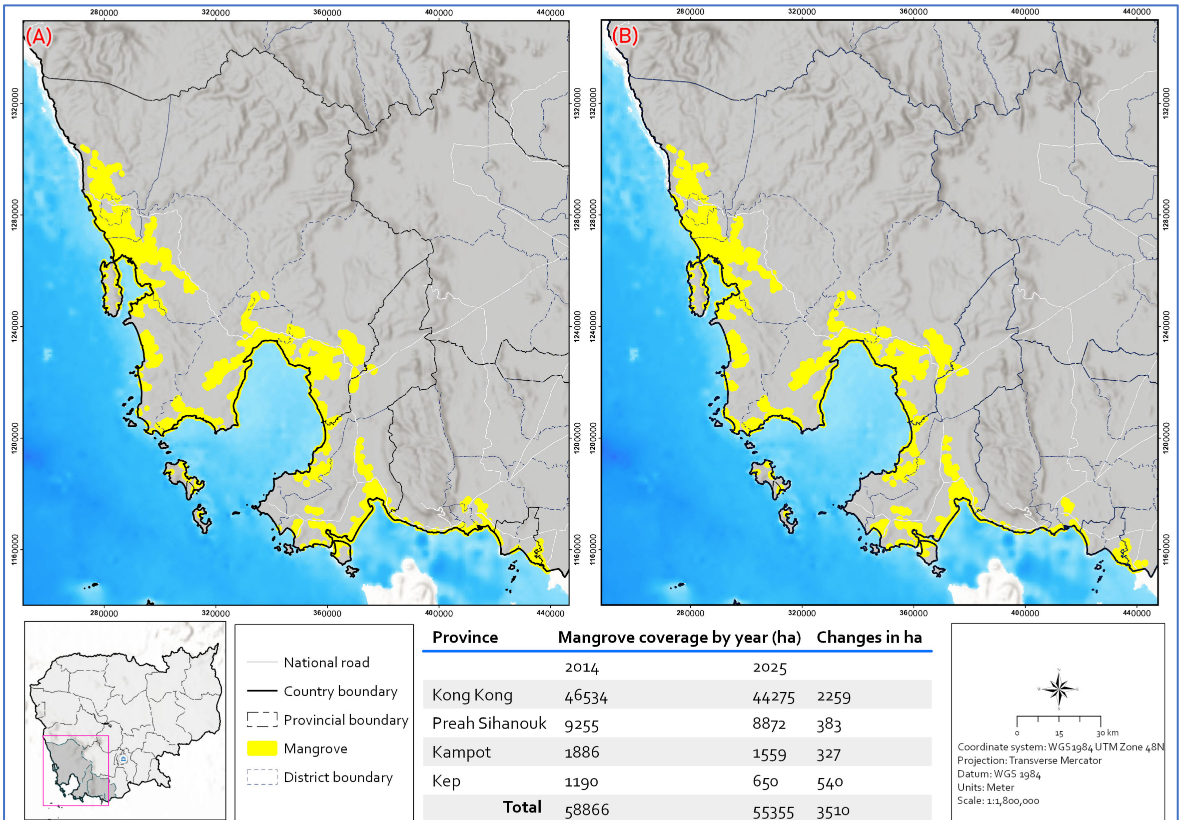
4.2 Current Status

4.2.1 Mangroves and Wetlands

See Annex 4-5 for the extended explanatory note on mangrove datasets, historical trends, and Ramsar wetland system connectivity relevant to the site-specific information presented in **Sections 4.2.1.1–4.2.1.2** below.

4.2.1.1 Status and distribution

Mangrove: National mangrove extent varies widely by dataset (≈45,000–63,000 ha) and is concentrated in Koh Kong with smaller estuarine belts in Kampot–Preah Sihanouk (Bunting et al., 2022; PEMSEA & MoE, 2019; MoE, 2025a). Historic statistics indicate substantial losses in the 1990s–2000s, but recent MoE mapping (Sentinel-2, 10 m) shows (Figure 4-1) a slower decline from **58,866 ha (2014)** to **55,355 ha (2025)** (−3,510 ha; ≈−319 ha/year; −6%). Losses are uneven: **Koh Kong accounts for ~64%** of the 2014–2025 loss, with smaller losses in Preah Sihanouk and fragmented parcels in Kampot and Kep.



Province	Mangrove coverage by year (ha)		Changes in ha
	2014	2025	
Kong Kong	46534	44275	2259
Preah Sihanouk	9255	8872	383
Kampot	1886	1559	327
Kep	1190	650	540
Total	58866	55355	3510

(A) Distribution of Mangrove Forest in 2025; (B) Distribution of Mangrove Forest in 2014

Figure 4-1 Maps of mangrove changes from 2014-2025
***Source:** MoE, 2025. Mangrove Assessment (on going project)*

Coastal wetlands: Cambodia's coastal wetlands and estuarine systems include the **Peam Krasaop Wildlife Sanctuary**, an extensive wetland complex recognized for its international importance under the Ramsar Convention. Peam Krasop complex and Koh Kapik & Associated Islets Ramsar Site—filter nutrients and sediments, support East Asian–Australasian Flyway migrants, and underpin small-scale fisheries (Ramsar Secretariat, 2012; Fauna & Flora, 2024). The Peam Krasaop wetland also hosts community fisheries (CFi) that engage in participatory management. MoE's efforts to develop management plans under the

SCS SAP highlight the need for integrated wetland management at both local and regional levels.

4.2.1.2 Selected site-specific status and pressures

Site 1. Botum Sakor National Park (Koh Kong)

Following the 2023 reclassification, **Botum Sakor NP is 143,895 ha (RGC, 2023)**. It includes **peat-forming mangroves (~4,768 ha; subset)** that are highly carbon-dense and sensitive to hydrologic disruption. Key pressures include infrastructure and concession-linked development that can restrict tidal exchange, plus legacy charcoal production and poaching. Management priority is "hydrology-first" protection (avoid drainage, maintain tidal connectivity, protect core peat zones (Girkin et al., 2022, UN-Habitat, 2019).

Site 2. Peam Krasop Wildlife Sanctuary (Koh Kong)

NSOC 2018 characterizes Peam Krasop as a **mangrove-dominated archipelago** of bays and islands with strong **inter-tidal** and **upstream freshwater** influence, supporting fisheries and ~**10,000 residents** dependent on aquatic resources and mangroves for fuelwood, and livelihoods (PEMSEA & MoE, 2019). **Peam Krasaop WS totals 16,982 ha** and is a mangrove–estuarine complex with strong livelihood dependence (Fauna & Flora, 2024). It is functionally connected to the **Koh Kapik Ramsar system**, forming one of Cambodia's most important mangrove–intertidal landscapes for fisheries and coastal protection (Fauna & Flora, 2024; Ramsar Secretariat, 2012). Main pressures are changes in hydrology and water quality linked to surrounding development, aquaculture expansion, and transport infrastructure (IUCN, 2017).

Site 3. Koh Kapik & Associated Islets (Ramsar Site 998) (Koh Kong)

The Koh Kapik–Peam Krasop Ramsar site (~12,000 ha) consists of low-lying alluvial islands, mangroves and intertidal flats, with ~60% inside Peam Krasop WS and ~40% outside. Freshwater from Prek Koh Pao and Prek Khlang Yai/Stung Kep maintains the brackish regime and the plankton–fish base supporting fisheries and waterbirds. The site hosts globally threatened species—e.g., **Nordmann's greenshank** and **Irrawaddy dolphin**—and underpins local livelihoods, with **>65% of households deriving 70–90% of income** from wetland resources (Ramsar Secretariat, 2012; Ly et al., 2023). Because Koh Kapik is tightly linked to Peam Krasop and Chrouy Pros seagrass, changes in freshwater inflow, channel infill, or mangrove fragmentation quickly affect fisheries and shorebird habitat, underscoring the need to maintain tidal prism and protect inter-islet flats.

Site 4. Prey Nob District / Ream NP context (Preah Sihanouk)

Ream National Park covers **~21,000 ha** (**≈6,000 ha marine**), containing a **mosaic** of mangroves, wetlands, **seagrass,** and coral reefs; multiple communes (around **30,000 people**) overlap/border the park, indicating high human–ecosystem interaction. Seagrass mapping recorded **≈98 ha** of meadows in Prey Nob (2021–2022), complementing historical estimates of **~1,800 ha** of mangroves in nearby Ream National Park (FiA/FAO, 2023). Forest change analyses reported **~5,490 ha** of forest loss in Ream NP between 2001 and 2021, signaling persistent pressure on coastal habitats and nursery connectivity (Dialogue Earth, 2023). Rapid urbanization and port/tourism growth have increased pollution and sedimentation risks, amplifying vulnerability to coastal storms and saline intrusion (JICA, 2010; UN-Habitat, 2019).

Site 5. Kampong Trach wetlands & Anlung Pring Protected Landscape (Kampot)

Anlung Pring Protected Landscape (**~219 ha**) is embedded within seasonal wetlands, shallow floodplains and rice mosaics; it is a **dry-season stronghold** for **Sarus Crane** and part of the **Kampong Trach** wetland complex), embedded in a wider mosaic of seasonal wetlands, rice fields, and shallow floodplains (Royal Government of Cambodia, 2023; EAAFP, 2019). Hydrologic modifications (e.g., small reservoirs, canals) and saline intrusion can disrupt seasonal inundation regimes essential for waterbirds and fisheries (ActionAid, 2021). NSOC also notes that **estuaries and tidal flats** across the coast are concentrated within protected areas (including **Botum Sakor, Ream, Dong Peng, Peam Krasop, Koh Kapik**), underlining the regional coherence of these wetlands (PEMSEA & MoE, 2019).

Site 6. Chumpu Khmao (Prey Nup)

Chumpu Khmao community fishery (CFi) landscape is part of a larger coastal wetland complex; recent restoration planted **12,500** mangrove saplings (April 2025) and complements broader protection under the Prek Kampong Smach MFMA (Khmer Times, 2025; Mangrove Alliance, 2025). Regional records document **Fishing Cat** (Vulnerable) in coastal mangroves, highlighting the area's wildlife value (Mukherjee et al., 2018). The Prey Nup cell lies between **Steung Hav** (610 ha seagrass) and **Kampot** meadows; **Prey Nup** itself holds **~98 ha** of mapped seagrass, useful for community monitoring of trawl exclusion and anchor management (FiA, 2023).

4.2.2 Coral Reefs and Seagrasses

See Annex 4-6 for the extended explanatory note on coral reef and seagrass status/distribution, mapping and monitoring considerations, and extended site-specific pressures and management implications relevant to **Sections 4.2.2.1–4.2.2.2** below.

4.2.2.1 Status and distribution

a) Coral Reef

Cambodia's coral reefs are mainly **fringing reefs** around the islands of **Koh Kong and Preah Sihanouk** (especially **Koh Rong**), with smaller turbidity-tolerant patches in **Kampot and Kep**. They support small-scale fisheries, dive tourism and shoreline protection. Early assessments estimated **~2,700 ha** of reef habitat, and condition in the 2000s was **fair–good** (≈23–58% live cover) but already affected by overfishing, illegal gears and declining water quality (UNEP/GEF; NSOC 2018). Long-term monitoring in Koh Rong (since 2010, later extended to Koh Sdach and Kep) shows sediment-influenced communities dominated by massive/encrusting corals (e.g., *Porites*, *Diploastrea*), and since 2019 the **Cambodian Coral Reef Monitoring Network (CCRMN)** has standardized protocols for fish biomass and benthic condition (FiA, 2023).

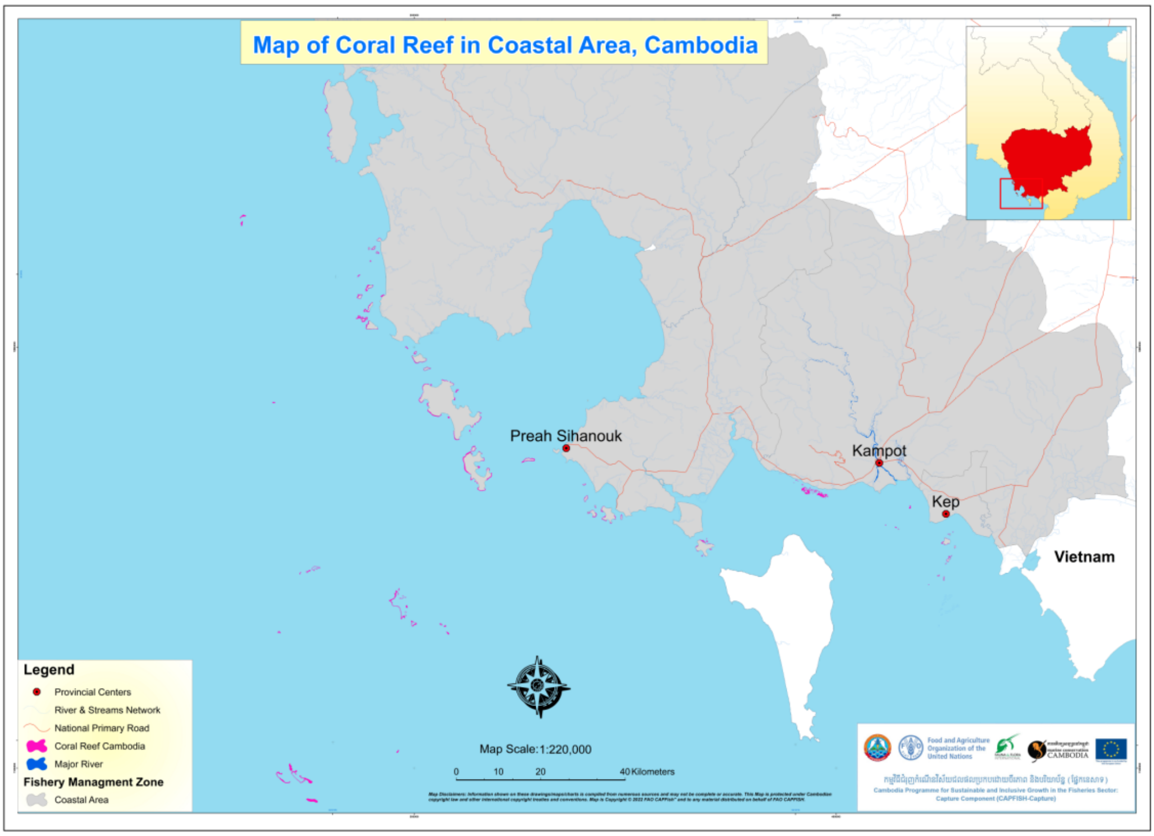


Figure 4-2 Location of coral reef distribution in Cambodia

Source: *FAO CAPFish, 2022.*

Cambodia likely hosts **~70 coral species**, but distribution data remain incomplete, particularly offshore. Recent mapping (2014 vs. 2025) indicates reefs remain concentrated in **Preah Sihanouk and Koh Kong (>85% of national cover)** with modest, method-bounded changes; restoration priorities include **Koh Rong Sanloem/Prek Svay** and larger Koh Kong reef complexes (MoE, 2025b).

b) Seagrass

Cambodia has extensive seagrass meadows, particularly in **Kampot and Koh Kong**, dominated by *Thalassia hemprichii*, *Halodule uninervis* and *Enhalus acoroides*. These meadows are key feeding grounds for dugongs and green turtles and provide major services—nursery habitat for coastal fisheries, sediment stabilization and blue-carbon storage. Recent surveys (2021–2023) distinguish **large mainland-adjacent meadows** and **smaller island/bay patches**. Mapped examples (~2,333 ha across 11 sites) include **Chrouy Pros Bay (~1,485 ha)**, **Steung Hav (610 ha)** and **Prey Nob (98 ha)**, plus smaller island patches (e.g., Koh Ta Kiev, Koh Bong, Koh Tang) (FiA, 2023). Key pressures are bottom-contact fishing (trawls/push-nets), dredging/shoreline works and land-based eutrophication; because many meadows lie within or near MFMAs and high-use corridors, improved gear control, dredging management and wastewater/runoff reductions are the most direct levers to stabilize seagrass extent and nursery function.

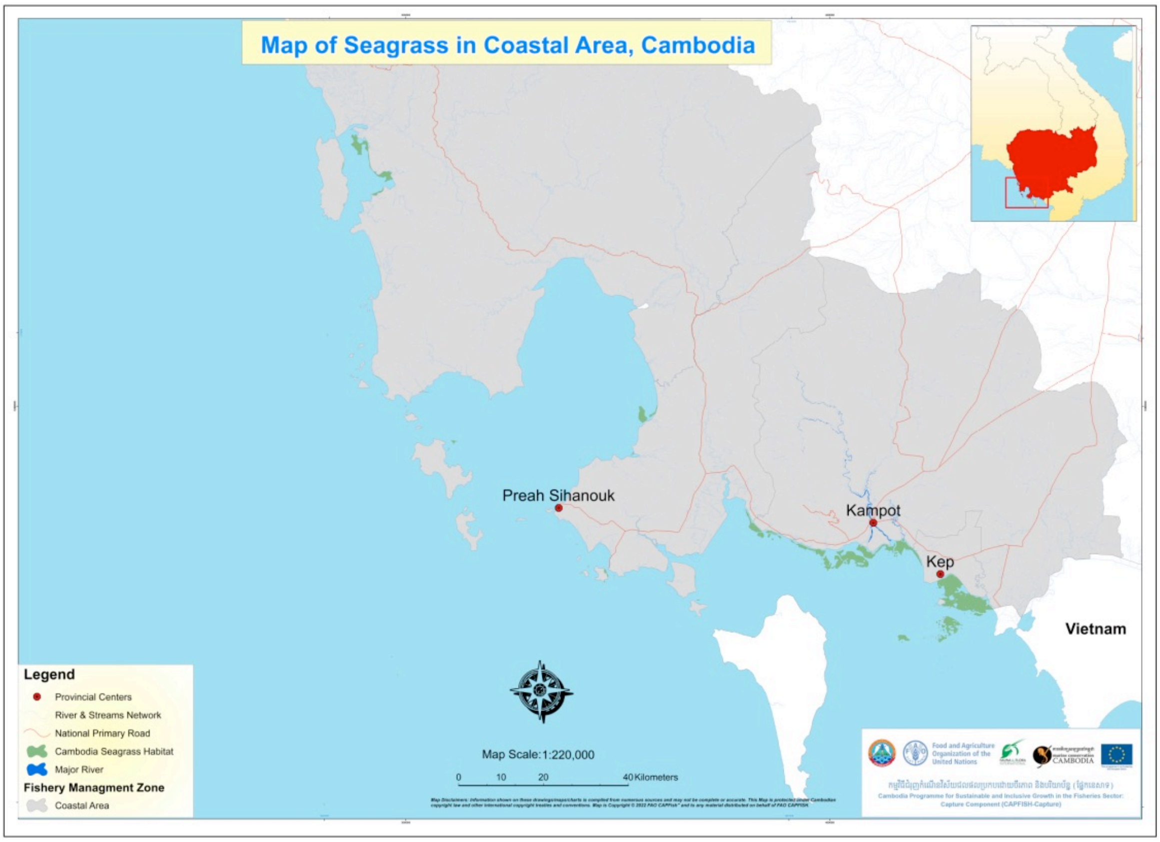


Figure 4-3 Location of Seagrass Distribution in Cambodia
Source: *FAO CAPFish, 2022.*

4.2.2.2 Selected site-specific status and pressures

Site 1. Koh Rong Archipelago (Koh Rong Marine National Park)

Koh Rong, first designated as a large MFMA and later a **National Marine Park (Feb 2018)**, spans ~520 km² (≈400 km² marine) and is Cambodia's core area for reef and island-seagrass conservation. MSP baselines map **~1,198 ha of coral reefs** and **~1,360 ha of seagrass** (MoE & NOTC, 2018). Reef surveys in 2019–2020 recorded **~29.8% coral cover**, dominated by sediment-tolerant **Porites** and **Diploastrea**, while fish biomass remains low due to continued fishing pressure (FFI, 2020). The archipelago's linked **reef–seagrass–mangrove system** is experiencing seagrass loss at **Prek Svay (−2,510 ha)** and **Koh Rong Sanloem (−908 ha)**, largely from tourism and infrastructure growth—underscoring the need for **no-anchor zones, moorings, and dredge controls**.

Site 2. Kep Archipelago (Koh Tonsay & Koh Pou) within the Kep MFMA.

The MFMA (~11.3 thousand ha) encompasses reefs and some of Cambodia's largest seagrass meadows (~6,399 ha). While pockets of high coral cover persist—such as **Koh Seh's 64% live cover** (409 colonies; 14 genera; low dead coral) in 2019 (Pham et al., 2025)—most nearshore reefs are small and sensitive to sedimentation and illegal gears. Proposed MFMA zoning and **anti-trawl structures** aim to curb bottom-contact fishing on adjacent meadows, supporting coral and seagrass recovery (FiA, 2023; Norrey et al., 2023). Persistent threats remain from illegal trawling and electric fishing.

Site 4. Kampot Beach / nearshore Kampot (proposed MFMA)

The most recent compilation shows a **Kampot nearshore belt** with **~5,158 ha seagrass** (10 spp.) and **~467 ha coral reef**, including a **~305 ha** single reef feature at **Nataya**—one of the largest single reef features on the mainland coast (MCC & FAO, 2023). Baseline assessments flagged sedimentation and gear impacts as principal pressures; a proposed **~8,486-ha** MFMA would formalize zoning and enforcement with three active Community Fisheries groups (Wild Earth Allies, 2020; MCC & FAO, 2023).

Site 3. Koh Sdach–Koh Kong Archipelago

Earlier surveys found "good" condition at several sites but increasing degradation signals over time; current CFi-level accounting shows the largest contiguous reef areas embedded in Samros Koh Sdec (≈57% of provincial CFi-mapped reef area) and Phnhy Meas (≈19%), which are recommended focal zones for transplantation and artificial-reef pilots given scale and connectivity (MoE 2025c).

4.2.3 Biodiversity Hotspots and Sensitive Areas

Three priority clusters stand out: Botum Sakor's carbon-dense peat-mangroves, requiring strict hydrological protection (Lo et al., 2018; Girkin et al., 2022); the Peam Krasop–Koh Kapik mangrove–intertidal system, vital for fisheries and migratory waterbirds (Fauna & Flora, 2024; Ramsar Secretariat, 2012); and the Kep–Kampot seagrass corridor, Cambodia's main seagrass and nursery stronghold but highly trawl- and turbidity-sensitive (MAFF/FiA, 2023; MCC & FAO, 2023).

Hotspot A: Botum Sakor peat-mangrove complex (Koh Kong): globally uncommon, carbon-dense, hydrology-limited

Botum Sakor contains **~4,768 ha of peat-forming mangroves** (peat 0.5–1.0 m; max ~1.35 m; ≥26 plant species), a rare feature in mainland SE Asia with very high blue-carbon stocks (Lo et al., 2018; Girkin et al., 2022).

- **Key pressures:** The system depends on intact tidal exchange; road embankments, canalisation and reclamation depress water tables and risk **irreversible peat oxidation and subsidence**.
- **Key indicators:** peat-zone water level, salinity/DO in creek heads, vertical land motion, mangrove canopy density, disturbance proximity.

Hotspot B: Peam Krasop–Koh Kapik complex (Koh Kong): one of mainland SE Asia's largest mangrove–intertidal systems, fisheries nursery & flyway node

Peam Krasop WS (16,982 ha) and the **Koh Kapik Ramsar Site (~12,000 ha)** form one of mainland SE Asia's largest mangrove–intertidal systems (Ramsar Secretariat, 2012; Fauna & Flora, 2024). They support small-scale fisheries and East Asian–Australasian Flyway waterbirds; **70–90% of nearby household income** is wetland-derived (Ramsar Secretariat, 2012; Ly et al., 2023). Function hinges on freshwater inflows (Prek Koh Pao; Prek Khlang Yai/Stung Kep) mixing with tidal exchange, and on connectivity to **Chrouy Pros seagrass (~1,485 ha)**.

- **Key pressures:** altered freshwater regimes, channel infill, mangrove cutting, charcoal legacy sites, and turbidity/nutrient loads.
- **Key indicators:** freshwater inflow, salinity bands, intertidal-flat area, juvenile-fish CPUE, wetland-income share, seagrass-edge integrity.

Hotspot C: Kep–Kampot seagrass corridor: national stronghold for meadow extent/richness and fisheries nurseries, yet trawling/turbidity-sensitive

Kep–Kampot hosts Cambodia's largest continuous seagrass belt (**Kep ~6,399 ha; Kampot ~5,158 ha; 10 spp.**) forming core nursery grounds for fisheries and feeding habitat for dugongs and turtles (MAFF/FiA, 2023; MCC & FAO, 2023). Over **30 CFis** help steward >24,000 ha of national meadows, with Kep–Kampot as the main anchor.

- **Key pressures:** bottom trawls/push-nets, sediment resuspension, turbidity from shoreline works and river plumes, and anchor scarring near tourist access points.
- **Key indicators:** meadow area by CFi, species richness, light attenuation (Kd), turbidity (NTU), trawl-scar density, megafauna sightings/feeding trails, and enforcement effort.

4.2.4 Endemic, Endangered, Threatened species

Cambodia's coastal ecosystems support several endangered and migratory species of global significance, including **dugong** (*Dugong dugon*, EN), **Irrawaddy dolphin** (*Orcaella brevirostris*, EN), and three marine turtles—**green** (*Chelonia mydas*, EN), **hawksbill** (*Eretmochelys imbricata*, CR), and **olive ridley** (*Lepidochelys olivacea*, VU)—as well as migratory shorebirds such as the **black-faced spoonbill** (*Platalea minor*, EN). **Irrawaddy dolphins** are present year-round in Kep waters, with documented strandings in 2017–2018 and at least one **dugong** bycatch event, highlighting ongoing gear-interaction risk (Tubbs et al., 2019). **Green** and **hawksbill** turtles forage and migrate along the coast, with sporadic nesting confirming national significance despite low abundance (Duffy et al., 2023). Coastal mangrove mosaics in the wider landscape also support the **Fishing Cat** (*Prionailurus viverrinus*, VU) and **smooth-coated otter** (*Lutrogale perspicillata*, VU), underscoring the cross-habitat value of estuarine and intertidal systems for threatened fauna (Mukherjee et al., 2018).

Figure 4-4 Dugongs with a new feeding trail in Cambodia's seagrass beds

Sources: MCC, retrieved from Khmer Time, at https://www.khmertimeskh.com/501750614/positive-signs-for-dugongs-with-a-new-feeding-trail-in-cambodias-seagrass-beds/

4.3 Discussion and conclusions

4.3.1 Priority transboundary biodiversity issues

Cambodia's coastal–marine ecosystems face interconnected pressures that spread easily across the semi-enclosed Gulf of Thailand, where limited exchange with the South China Sea allows impacts to cross EEZ boundaries (PEMSEA & MoE, 2019). In line with the SCS-SAP, six priority issue clusters dominate: marine pollution, overfishing and IUU, habitat degradation, climate-change impacts, biodiversity loss, and emerging risks linked to hydrologic and sediment connectivity (PEMSEA & MoE, 2019; Ramsar Secretariat, 2012; World Bank, 2020; Norrey et al., 2023; Tubbs et al., 2019; Duffy et al., 2023).

4.3.1.1 Marine Pollution

Untreated municipal wastewater, industrial effluents, agricultural runoff, marine litter and ship-based discharges are the main coastal pollution pathways; once released, they disperse across the Gulf with currents (PEMSEA & MoE, 2019; World Bank, 2021). Water-quality management follows ASEAN Marine Water Quality Guidelines, yet estuaries like Sihanoukville/Kampot show nutrient enrichment and episodic algal blooms (ASEAN Secretariat, 2008/2012; PEMSEA & MoE, 2019). SEZ effluents add BOD/metals, while agricultural runoff drives turbidity that stresses reefs and seagrass (PEMSEA & MoE, 2019). Mismanaged plastics—especially from Sihanoukville—plus ghost gear heighten transboundary debris risks, and growing port activity raises oil-spill risk, underscoring the need for stronger contingency planning (PEMSEA & MoE, 2019; World Bank, 2020, 2021).

Figure 4-5 Wastewater runoff discharging onto a tourist beachfront
Sources: *PEMSEA & MoE, 2019.*

4.3.1.2 Overfishing and IUU Fishing

Shared small pelagic stocks (anchovies, sardines, mackerel) migrate across EEZs; cumulative pressure is evident Gulf-wide in long-series statistics (FAO, 2024). Cambodia's coastal landings have fluctuated in the 2000s–2020s, with artisanal fishers reporting longer trips for smaller catches—trends aligned with regional declines in coastal demersal and small pelagic documented since historical trawl surveys (FAO, n.d.). IUU fishing remains a transboundary challenge; Cambodia's NPOA-IUU (2020–2024) and the National Plan of Control & Inspection (NPCI) 2020–2024 target illegal trawling, border incursions, and high-risk habitats like seagrass and coral (FiA/MAFF, 2020a; FiA/MAFF, 2020b). Bottom trawling's collateral damage to seagrass in Kampot–Kep is repeatedly reported in national/partner technical documents (FiA/MAFF, 2023).

4.3.1.3 Habitat Degradation and Loss

Global Mangrove Watch v3.0 shows Cambodia's mangroves at ~62–63 thousand ha in 2020, with most losses occurring in the 1990s–2000s and driven by aquaculture conversion, charcoal production and coastal development (Bunting et al., 2022; PCAsia, 2024; PEMSEA & MoE, 2019). Coral reefs in Koh Rong/Koh Rong Sanloem and the Kep–Kampot archipelagos face sedimentation, destructive fishing and heat-stress bleaching; the 2010 Gulf-wide bleaching event and later heat anomalies are reflected in declining but generally fair–good coral-cover ranges (PEMSEA & MoE, 2019). Seagrass meadows are extensive and transboundary, with ~33,800 ha attributed to Cambodia—largest in Kampot (UNEP/GEF SCS, 2008; SCS-SAP National Profile, 2021). Repeated degradation from trawling, dredging and sedimentation is documented (FiA/MAFF, 2023), and blue-carbon syntheses highlight the high carbon stocks of Cambodian seagrasses, making losses significant for long-term carbon sequestration (Fourqurean et al., 2012).

4.3.1.4 Biodiversity Loss and Migratory Species Decline

Endangered megafauna—dugongs, marine turtles, Irrawaddy dolphins—and migratory shorebirds depend on transboundary habitat networks and face cumulative threats (UNEP/GEF SCS, 2008; FiA/MAFF, 2023). Recent observations of dugong feeding trails in Cambodian seagrass underscore continued, low-abundance presence and cross-border movements with Viet Nam (Khmer Times/MCC, 2025).

4.3.1.5 Climate Change and Associated Impacts

Sea-level rise (SLR), warming, extreme events, and ocean acidification amplify all other pressures. IPCC AR6 WGII (Chapter 10) projects continued SLR with many Asian coasts exceeding the global mean; rising surge and wave risks compound exposure for the Gulf (IPCC, 2022). The World Bank Climate Change Knowledge Portal synthesizes Cambodia projections and SLR-inundation risk for low-lying Koh Kong–Kampot coastlines (World Bank & GFDRR, 2021/2024). Recurrent bleaching/heat stress in 2010 and 2019–2020 is noted in regional monitoring and national summaries (IPCC, 2022; PEMSEA & MoE, 2019).

4.3.1.6 Emerging Environmental Issues

Large-scale port expansion and coastal reclamation alter sediment budgets and hydrodynamics (World Bank, 2021). Rapid growth in **ports/SEZs**, tourism, and urban construction has outpaced wastewater and solid-waste systems, driving nearshore pollution with transboundary consequences (World Bank, 2021; PEMSEA & MoE, 2019). Offshore oil & gas elevate spill risk; preparedness and response capacity are ongoing priorities (PEMSEA & MoE, 2019). Microplastics are an emerging concern across ASEAN coasts; regional baselines and Mekong studies report microplastics in waters/biota and call for harmonized monitoring (GIZ, 2024; MRC, 2024).

4.3.2 Risk Assessment and Valuation of Economic Losses

With >65% of Koh Kapik households wetland-dependent, ~11,500 ha of seagrass in Kep–Kampot, and reefs generally "fair" with high-value refugia, even small management lapses can trigger disproportionate economic losses. Conversely, low-cost actions—peat-mangrove hydrologic safeguards, anti-trawl structures and CFi patrol fuel, and basic wastewater upgrades—deliver high benefit–cost returns once avoided income losses, avoided damages, and blue-carbon values are included (Ramsar Secretariat, 2012; FFI, 2020; Norrey et al., 2023; World Bank, 2021; Fourqurean et al., 2012).

4.3.2.1 Livelihood risk and losses

Household dependence around Koh Kapik–Peam Krasop is exceptionally high: more than 65% of households derive 70–90% of income from wetland-based fishing and gleaning (Ramsar Secretariat, 2012; Ly et al., 2023). Under a conservative elasticity (income roughly proportional to catch for small-scale fishers), a **10–20% reduction in nursery function or access** would transmit almost one-for-one to **village income losses of 10–20%,** with second-round effects on food security and debt service for the poorest quintiles (Ramsar Secretariat, 2012; Ly et al., 2023). When shocks are spatially covariate (e.g., a mangrove die-back or a major pollution event), coping options shrink and recovery times lengthen, amplifying welfare losses relative to idiosyncratic shocks.

4.3.2.2 Blue-carbon opportunity costs

The **Botum Sakor peat-mangrove complex (~4,768 ha)** stores very large carbon stocks; hydrological disturbance (culverts/roads, drainage) risks **peat oxidation and subsidence**, resulting in long-lived CO_2 emissions and the loss of storm-buffering capacity (Lo, Quoi, & Visal, 2018; Girkin et al., 2022). Even without a site-specific MRV, applying standard blue-carbon ranges for mangrove peat implies that preventing oxidation yields **avoided emissions** valued under emerging carbon finance; conversely, failure to maintain water levels creates a liability via foregone credits plus increased disaster losses from weakened surge attenuation (Girkin et al., 2022; Lo et al., 2018).

4.3.2.3 Reef deterioration

Coral communities in Koh Rong MNP average ~30% live cover and are dominated by sediment-tolerant massive taxa, though pockets of high cover persist in Kep (e.g., Koh Seh ~64%) (FFI, 2020; Pham et al., 2025). Reef degradation reduces structural complexity and nursery/refuge functions, which can directly depress reef-associated catch and incomes for small pelagic and demersal handline and trap fisheries in coastal fishing communities (FFI, 2020). It also threatens tourism: declining reef quality reduces dive and snorkel demand, and regional evidence suggests even moderate live-cover losses can cut dive days and operator revenue (Burke et al., 2011). Reefs also dissipate wave energy; their decline increases expected annual damages to beachfront assets and public infrastructure during storm seasons (Burke et al., 2011). In the semi-enclosed Gulf of Thailand, cumulative pressures—overfishing, destructive gear, sedimentation, and mass bleaching—create transboundary costs as fish move across EEZs and tourism markets benchmark regionally (PEMSEA & MoE, 2019; Burke et al., 2011).

4.3.2.4 Seagrass losses

Kep–Kampot (≈11,500 ha combined; ~10 species in Kampot) and Chrouy Pros/Prey Nob (≈1,583 ha combined) anchor Cambodia's seagrass extent but are sensitive to bottom trawling, turbidity, and dredging (MAFF/FiA, 2023; MCC & FAO, 2023; FiA/FAO, 2023).

Historical assessments indicate major contractions in parts of the Kep–Kampot corridor, with mixed dynamics over 2014–2025—localized recovery where anti-trawl enforcement is sustained, and continued attrition where turbidity and shoreline works intensify (MAFF/FiA, 2023; MCC & FAO, 2023). These changes create economic risks through reduced nursery function, lowering catches and incomes for small-mesh gillnet and trap fleets targeting juvenile coastal finfish and invertebrates. Degraded meadows may also concentrate fishing effort and raise entanglement risk for Irrawaddy dolphins and dugongs, causing biodiversity losses and reputational/tourism costs (Tubbs et al., 2019; Duffy et al., 2023). Finally, seagrasses are important blue-carbon stores (global mean ~139 Mg C_org ha^{-1} in biomass plus soils), so meadow loss implies forgone sequestration and potential emissions from disturbed sediments (Fourqurean et al., 2012).

4.3.3 Current management and institutions

4.3.3.1 Lead agency and coordination

The Ministry of Environment (MoE) is the lead agency for coastal and marine environmental management. MoE administers the Code on Environment and Natural Resource (2023) and Protected Areas Law (2008) and designates/manages national protected areas and Marine National Parks (MNPs). MoE coordinates closely with the FiA/MAFF, Ministry of Water Resources and Meteorology (MOWRAM), provincial departments, and local authorities through inter-agency Coastal Coordination Committees chaired by provincial governors with MoE technical support (PEMSEA & MoE, 2019). This arrangement overlays MoE's conservation mandate (Protected Areas Law, 2008) with FiA's fisheries/ecosystem management and co-management mandate (Fisheries Law, 2007) (Royal Government of Cambodia, 2007, 2008; PEMSEA & MoE, 2019).

4.3.3.2 Key sites and zoning coherence

Protected areas, MFMAs, Ramsar sites and community management: Cambodia's coastal governance combines MoE-managed protected areas (e.g., Botum Sakor National Park; Peam Krasop Wildlife Sanctuary) and internationally designated wetlands (Koh Kapik and Associated Islets Ramsar Site) with MAFF/Fisheries Administration area-based fisheries measures (MFMAs/EAFM) and community co-management (CFis/CPAs). Key overlaps require clear zoning and joint enforcement: the Koh Rong Archipelago MFMA (Prakas, 2016) was later designated as Koh Rong Marine National Park under MoE (Sub-decree No. 14, 2018; 52,498 ha), so rules, patrols and user rights need MoE–FiA alignment. In Kep, the Kep Archipelago MFMA (Prakas No. 193, 2018) covers Koh Po and Koh Tonsay and complements adjacent protected-area and seagrass stewardship efforts. Along the Koh Kong coast, Koh Kapik Ramsar Site overlaps PKWS and parts of the wider Botum Sakor landscape, highlighting the need to manage mangrove/peat systems coherently across instruments and concessions. In Kep–Kampot, operational and proposed MFMAs link CFis across contiguous seagrass/reef belts. Community participation is widespread, with **>70 CFis** across the four coastal provinces supporting inshore fisheries management alongside CPAs in mangrove blocks (FiA/MAFF, 2023; PEMSEA & MoE, 2019). Table 4-*1* summarizes the main MPAs and OECM-related measures discussed in this chapter and highlights where habitat priorities (mangroves, wetlands, coral reefs and seagrass) align—or potentially conflict—across different management instruments.

Table 4-1 Cambodian MPAs and OECMs: Coastal area-based management: MPAs, Ramsar systems, MFMAs/EAFM, and community co-management

Name of MPAs and OECMs	Year of establis h	Year of update	Total Area (ha)	Mangrove area (ha)	Wetland area (ha)	CR area (ha)	SG area (ha)

Butom Sakor National Park	1993	2023	**143,895**	**4,768 peat-forming mangroves, subset**	--	--	--
Peam Krasop Wildlife Sanctuary	1993	2023	**16,982**	9,000	2,500 (Connect Koh Kapik Ramsar ~12,000)	--	Connect: Chrouy Pros (~1,485 ha)
Prey Nob Protected Area				9,351	--	--	98
Preah Sihanouk Ream National Park	1993	2023	21,000	6,500	1,800	--	--
Kep NP + Kampot coastal designated area	1993	2023	Kep: 5,000 Kamot: 7,200	800	350	--	--
Koh Po and Koh Tonsay Archipelago	2018	--	11,307	--	--	67.83	3,900
Koh Rong MFMA	2016	--	40,535	--	--	624	--
Koh Rong MNP	2018	--	52,498	--	--	1,198	1,360

Note: Available Habitat-area figures (mangroves/wetlands/coral/seagrass) are not consistently reported in legal instruments and are often based on mapping or project sources; they should be treated as **indicative** and should not be summed across habitats to avoid double counting. See Annex 4-7 for the extended explanatory note for Coastal area-based management: MPAs, Ramsar systems, MFMAs/EAFM, and community co-management

4.3.3.3 Management tools in practice

A broader suite of management tools has emerged in the past five years, combining spatial protection, community enforcement, and improved monitoring. **No-take zones and seasonal closures** now safeguard key reef–seagrass nurseries (FFI, 2020; FiA/MAFF, 2023), while **community patrols with FiA/MoE** continue to deter inshore trawling, compressor fishing and destructive gears (FFI, 2020; PEMSEA & MoE, 2019). **Anti-trawl structures** placed along sensitive meadow margins help exclude trawls, cut sediment resuspension, and support recovery where local enforcement is consistent (Norrey et al., 2023). Parallel investments in **updated habitat mapping and monitoring**—including community-led reef/seagrass surveys, seabed baselines and periodic water-quality checks—guide adaptive zoning and track outcomes (FiA/MAFF, 2023; FFI, 2020). Where resources such as boats, fuel, stipends and data systems are sustained, these measures show early signs of seagrass and reef improvement.

On land-based pressures, MoE's **National Waste Management Strategy and Action Plan 2018–2030** underpins marine-litter reduction, with pilot segregation and beach-cleanup programs in Sihanoukville and Kampot and initial work on a **National Source Inventory for Plastics** (MoE, 2018; World Bank, 2021; PEMSEA & MoE, 2019). MoE also conducts **periodic water-quality monitoring** in Sihanoukville, Kampot and Koh Kong—analysing BOD, nutrients, coliforms and plastics—where repeated exceedances of ASEAN marine-water benchmarks have prompted stronger wastewater and drainage controls (ASEAN Secretariat, 2008/2012; PEMSEA & MoE, 2019).

4.3.4 Gaps and Priority Challenges

Despite progress in laws, institutions, and pilots, Cambodia still faces structural and operational barriers to effective coastal and marine ecosystem and biodiversity management. These gaps cut across policy, governance, technical, financial, social, and regional dimensions and constrain responses to the transboundary issues identified earlier (PEMSEA & MoE, 2019; World Bank, 2021).

4.3.4.1 Policy and Legal Gaps

Cambodia has core environmental and sectoral laws—the Code on Environment and Natural Resource (2023), the Law on Fisheries (2007), and the Protected Areas Law (2008)—but they do not yet amount to an enforceable, integrated coastal zone management regime; mandates are dispersed and coordination provisions are limited (PEMSEA & MoE, 2019). While environmental impact assessments are required (Sub-Decree on the Environmental Impact Assessment Process), practice and monitoring have been uneven, and cumulative/transboundary effects are rarely assessed systematically (Royal Government of Cambodia, 1999; Cambodia Law & Policy Journal, 2015). Pollution control and marine-litter provisions are still developing; recent policy work urges clearer standards and penalties for coastal dischargers and port/oil-spill risks (PEMSEA & MoE, 2019; World Bank, 2021).

4.3.4.2 Institutional and Governance Challenges

Institutional capacity constraints—staffing, equipment, and budget—limit monitoring and enforcement at provincial level for both MoE and the Fisheries Administration (PEMSEA & MoE, 2019). Overlaps among MoE, MAFF, MLMUPC and sub-national authorities create gaps and duplication without a robust, formal coordination mechanism for the coast (PEMSEA & MoE, 2019). Decentralization has expanded local roles, but many sub-national administrations and community institutions (CFis/CPAs) still need stronger legal authority and sustained support to enforce rules (PEMSEA & MoE, 2019).

4.3.4.3 Technical and Data Gaps

Long-term, spatially consistent datasets on habitat condition, fish stocks, pollution, and biodiversity remain limited and fragmented across agencies; no centralized open system curates coastal/marine data for decision-making (PEMSEA & MoE, 2019). National and regional studies note gaps in microplastics, species movements, and socio-economic impact evidence and call for harmonized indicators and joint monitoring (GIZ, 2024; MRC, 2024; PEMSEA & MoE, 2019). Laboratory capacity, remote-sensing/GIS tools, and routine staff training in ecosystem-based management and climate risk assessment are still insufficient in many coastal provinces (PEMSEA & MoE, 2019).

4.3.4.4 Financial Constraints

Budgets for environmental monitoring, compliance, and community engagement are modest relative to need; donor projects are often time-bound and site-specific, with limited mechanisms for sustained O&M (PEMSEA & MoE, 2019; World Bank, 2021). Economic instruments (e.g., MPA user fees, pollution charges, and PES/blue-carbon finance) are nascent, constraining durable financing for MPA enforcement and pollution control (World Bank, 2021).

4.3.4.5 Enforcement and Compliance Issues

Illegal mangrove clearance, unregulated coastal construction, and untreated industrial discharges persist amid limited inspections and sanctions (PEMSEA & MoE, 2019). For fisheries, patrols and monitoring-control-surveillance remain capacity-constrained; Cambodia adopted the National Plan of Action to Prevent, Deter and Eliminate IUU Fishing (2020–2024) and the National Plan of Control and Inspection for Marine Fisheries (2020–2024), but implementation challenges remain (FiA/MAFF, 2020a, 2020b; SEAFDEC, 2025). Judicial handling of environmental cases and the sensitivity of actions involving influential actors also weaken deterrence (PEMSEA & MoE, 2019).

4.3.4.6 Limited Awareness and Participation

Public awareness of long-term ecological consequences remains uneven; private investors may lack incentives or knowledge to comply with safeguards. Where community CFis/CPAs are engaged, results improve, but inclusive consultation and co-management are not yet systematic across provinces (PEMSEA & MoE, 2019).

4.3.4.7 Regional and Transboundary Challenges

Cambodia participates in **ASEAN**, **COBSEA**, and **PEMSEA**, yet joint monitoring, harmonized standards, and shared stock assessments remain limited; oil-spill readiness and marine-litter monitoring are not fully aligned across Gulf countries (PEMSEA & MoE, 2019). Disparities in legal frameworks and capacity across borders create enforcement loopholes exploited by IUU fleets (FiA/MAFF, 2020a, 2020b).

4.3.5. Recommended Priority Actions

a) Strengthening legal and policy frameworks

Existing laws should be revised and operationalized with explicit ICZM provisions, and the mandate of the NCCMD clarified. A National Coastal and Marine Policy should align ministry roles and set measurable objectives for pollution control, habitat conservation, and fisheries management. In the medium term, marine spatial planning (MSP) regulations should be enacted to zone areas for conservation, fisheries, industry, and tourism, anchored in the Pentagonal Strategy and SDG 14.

b) Building institutional capacity and coordination

Priorities include expanding MoE coastal monitoring units with laboratory capacity and GIS/remote-sensing capability, and formalizing an inter-ministerial ICZM mechanism (MoE, FiA/MAFF, MLMUPC, and provinces) to resolve overlaps and improve implementation. Decentralization should be strengthened through training on coastal planning, enforcement, and climate risk for subnational authorities. Community governance should be reinforced by supporting CFis/CPAs with legal recognition, technical training, and micro-grants, scaling lessons from Peam Krasop and Koh Rong.

c) Enhancing data, research, and technology

A national coastal–marine data centre hosted by MoE should curate water quality, habitat maps, fisheries, and socio-economic data and connect to regional platforms. Long-term monitoring should be expanded for nutrients, marine litter, habitat condition, and fish stocks, supported by Sentinel/satellite mapping, drones for patrols, and VMS/e-CDT for fisheries. Partnerships with universities, UNEP/COBSEA/PEMSEA, and development partners should support methods and technology transfer.

d) Securing sustainable financing

Financing should combine higher domestic allocations with instruments such as MPA user fees/eco-levies, payments for ecosystem services, and blue-carbon finance for mangroves/seagrass. Public–private investment should be blended for wastewater and solid-waste infrastructure, and a share of environmental fines earmarked for site-level O&M and community patrols.

e) Strengthening enforcement and compliance

Resources for inspectors and MCS patrols should increase, alongside graduated, transparent penalties and case tracking. Risk-based inspections should be expanded and supported by wider roll-out of VMS/e-CDT. Community co-enforcement should be enabled through hotlines and feedback loops that trigger action and ensure report-back.

f) Raising awareness and education

Targeted campaigns for communities and operators should emphasize ecosystem values and the costs of degradation. Coastal topics should be integrated into school curricula, while green-tourism certification and marina/harbour best practices are promoted. National marine-litter awareness and source-reduction programmes should be expanded.

g) Climate change adaptation and resilience

Climate risk screening should be mainstreamed in coastal permits and designs, supported by enforceable setbacks and ecosystem-based adaptation (mangrove restoration; reef/seagrass protection). Early-warning systems should be strengthened and livelihoods diversified (climate-smart aquaculture, eco-tourism). Actions should align with Cambodia's NDC and NAP to mobilize adaptation finance.

h) Regional and transboundary cooperation

Bilateral cooperation with Viet Nam and Thailand should address shared stocks, IUU control, and oil-spill response. Cambodia should engage actively in ASEAN/COBSEA monitoring networks and promote harmonized Gulf standards on water quality, litter metrics, and emergency protocols. Data sharing and replication of community-based management models should be pursued through PEMSEA and SEAFDEC channels.

4.4 Methodology and Analyses

This section describes how ecosystem status and trends were assessed for Cambodia's coastal zone (mangroves/wetlands, coral reefs, and seagrasses), how pressures and governance responses were integrated, and how risks and economic implications were derived. Analyses cover the four coastal provinces with site zoom-ins at Botum Sakor, Peam Krasop–Koh Kapik, Koh Rong Archipelago, Kep–Kampot, and selected seagrass/reef cells. The report was structured by thw main steps include:

1. **Frame questions & spatial extent.** Define policy-relevant questions (extent, condition, pressures, risks) and map analysis boundaries (PAs, MFMAs, CFis, 20-km coastal buffer; reef/seagrass polygons).
2. **Assemble datasets.** Compile official monitoring, partner surveys, and remote-sensing products; standardize to common projection and metadata
3. **Construct indicators.** Calculate ecosystem-specific extent/condition and cross-cutting pressure/governance indicators; harmonize units and baselines.

4. **Detect change & hotspots.** Apply time-series comparisons and pressure–state overlays; identify sensitivity "hotspots" using multi-criteria thresholds.
5. **Risk & valuation.** Translate ecological change into expected livelihood, protection, and carbon consequences using transparent assumptions.
6. **Triangulate & QA/QC.** Cross-check with field notes, partner reports, and independent products; document uncertainty.
7. **Synthesize for management.** Aggregate results to provincial/site summaries and map actionable priorities.

*(All datasets, processing parameters, assumptions, and full citations are provided in **Annex**)*

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.

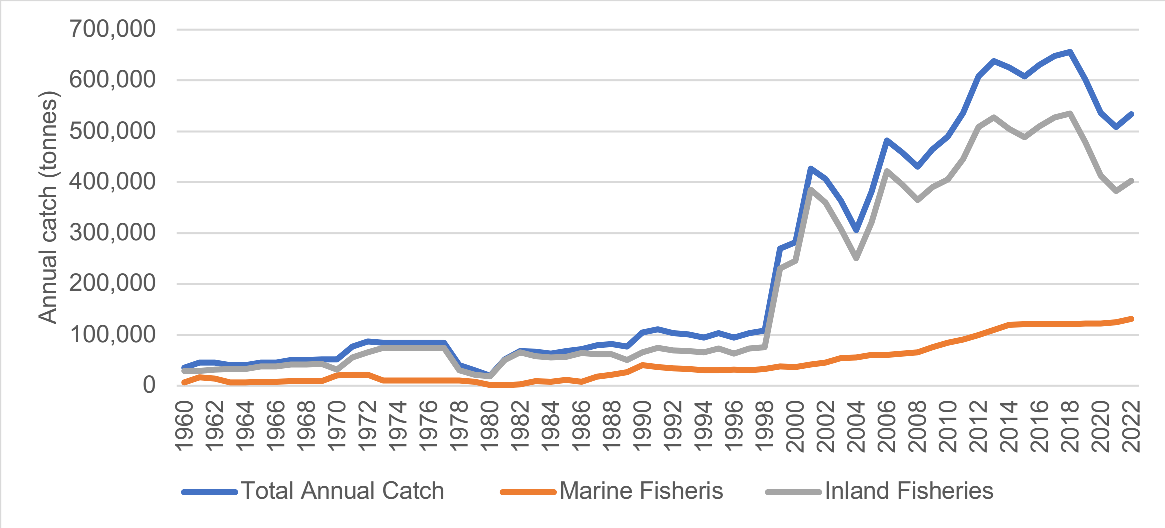


Figure 5-1 Capture fisheries production in Cambodia, 1960–2022 (total vs. marine vs. inland)

***(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.

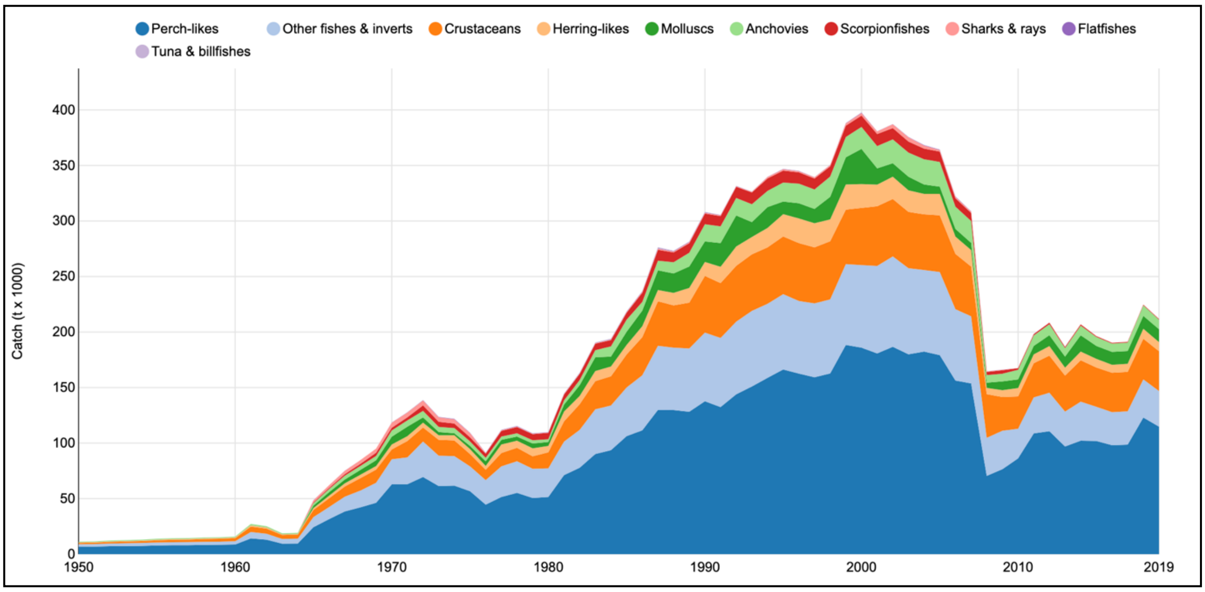


Figure 5-2 Catches by commercial groups in the waters of Cambodia (1950-2019)

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).

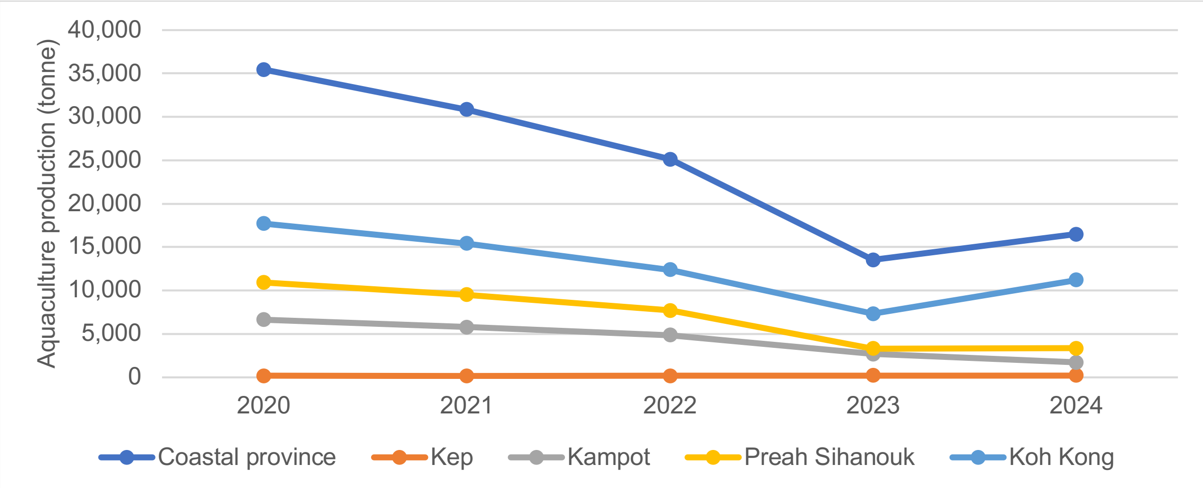


Figure 5-3 Coastal provinces aquaculture trend (2020–2024)

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.

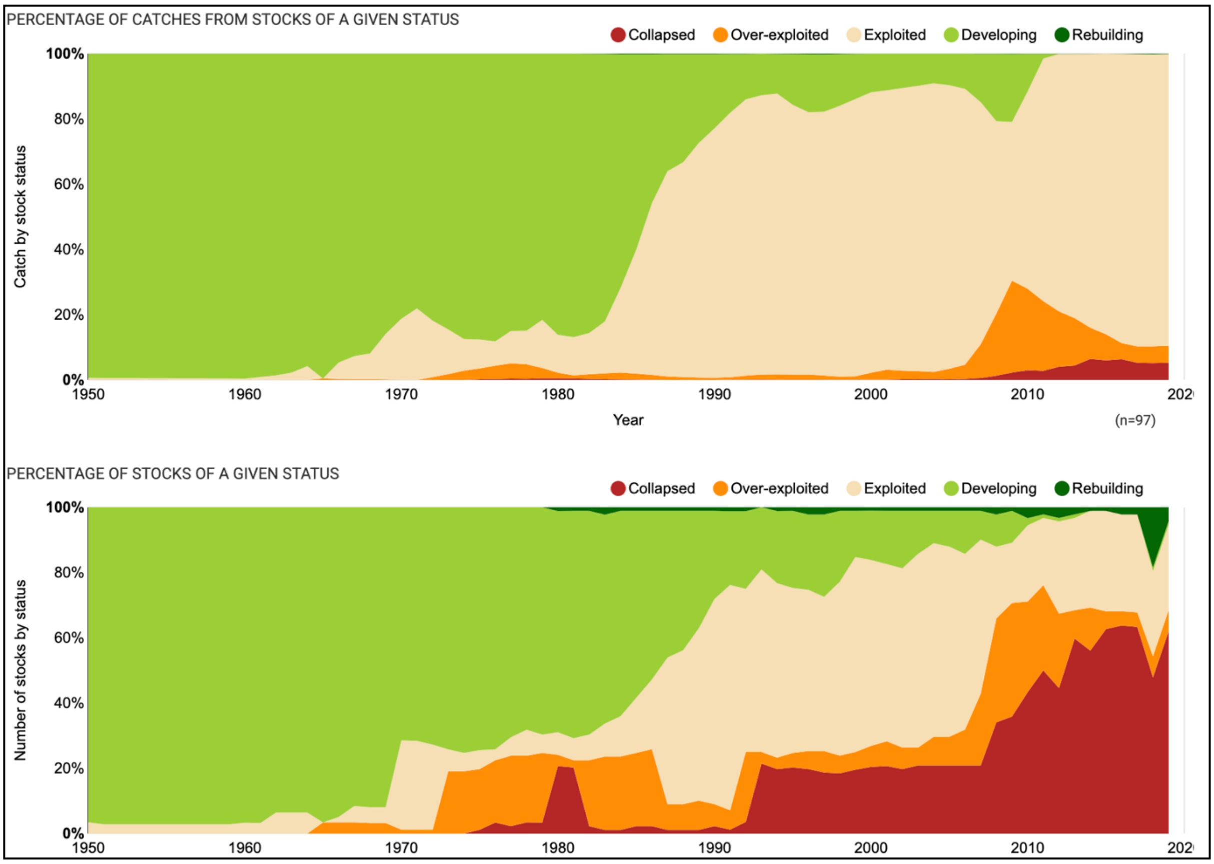


Figure 5-4 Stock status in the waters of Cambodia (1950–2019)

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.

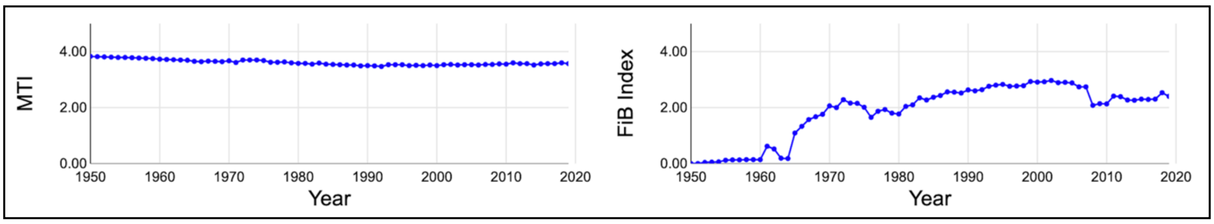


Figure 5-5 Mean trophic level (Marine Trophic Index or MTI) and FiB index in Cambodian waters

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.

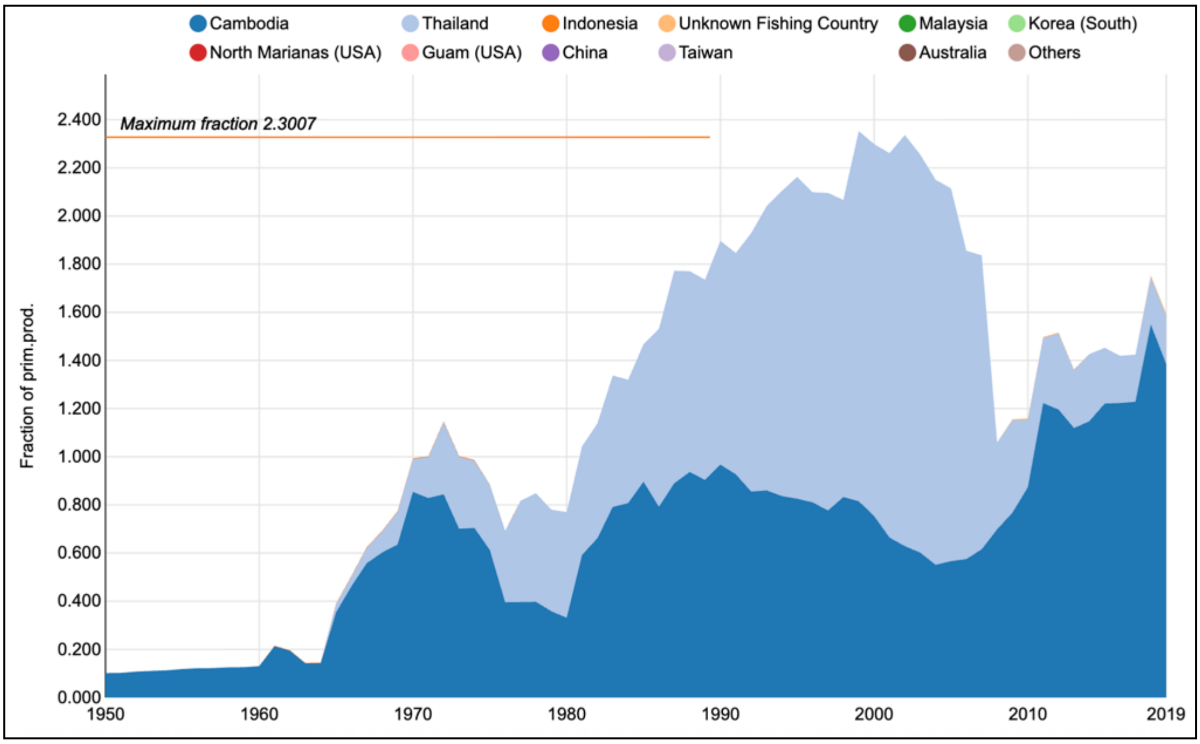


Figure 5-6 Primary Production Required for catches in the waters of Cambodia

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.

6. Governance
6. Governance

6.1 Key Findings

- **Rapid growth with rising coastal pressures.** GDP increased from US$3.7 billion (2000) to about US$46 billion (2024), and GDP per capita from ~US$300 to >US$2,600. High investment (≈30–34% of GDP) and strong FDI (≈9–10%) are driving ports, tourism and industrial estates that intensify pressure on coastal and marine resources.
- **Sustainable-finance tools emerging, but marine funding remains limited.** New instruments—sustainable finance principles, a green taxonomy and bond guarantees—create space for blue/green bonds, yet fisheries conservation budgets remain modest (≈US$150,000–440,000, 2013–2020).
- **Expanding PPP and infrastructure pipeline.** The PPP Law and VGF have enabled more than a dozen solicited and several unsolicited projects, including logistics hubs and tourism ports, offering opportunities for the blue economy but requiring stronger integration with ICZM/MSP.
- **ICZM institutions and laws exist, but mandates at sea are incomplete.** NCCMD, NCSD, line ministries and PCCMDs form a multi-level structure supported by modern laws. However, the marine mandate for NCCMD is still pending and UNCLOS is not yet domestically ratified.
- **Protected areas and data systems improving but not yet effective at scale.** Koh Rong MFMA/MNP, Kep and Prek Kampong Smach MFMAs, plus Ramsar/coastal PAs, form a growing network. FiA's marine catch monitoring and 6.5.1/6.5.2 scores (≈62% IWRM; 98% transboundary coverage) show progress, but patrol assets, prosecutions, O&M budgets and adaptive management remain insufficient.
- **Civil society and private actors are central but unevenly resourced.** CFis/CPAs, NGOs and major projects, lead co-management, monitoring and restoration. Tourism and port operators are increasingly engaged, yet committee capacity, stable financing and fair grievance/benefit-sharing mechanisms remain limited.

6.2 Current Status

6.2.1 Economic and Policy Drivers

6.2.1.1 Political–economic drivers and trends

Cambodia's GDP expanded from US$3.7 billion (2000) to US$46.4 billion (2024e), with GDP per capita rising from US$296 to US$2,628. Real growth averaged 7–8% pre-COVID, contracted –3.6% in 2020, and recovered to ~5–6%, with ~4% projected for 2025 (World Bank, 2025a; 2025b; FRED/WB, 2025). This trajectory drives—and strains—coastal development, ports, extractives and tourism in the SCS/GoT interface.

Table 6-1 Summary of Cambodia key selected economic indicators (2020 – 2024)

Key Economic Indicators	2020	2021	2022	2023	2024
GDP (current US$) - Billions	34.82	36.79	39.99	42.34	46.35
GDP (annual % of change)	-3.56	3.09	5.13	5.01	6.02
GDP per capital (current US$)	2081.74	2167.40	2325.03	2429.75	2627.88

Sources: World Bank Group, Cambodia Data (WDI). *See Annex Table 6-2 for more detail of the trend of key economic indicators)*

Public finance remains prudent (debt ~24–27% of GDP in the 2010s; ~29% projected for 2025), creating space for blue-economy investment if safeguards are strong, while inflation is moderate and the current account deficit persists due to import-intensive investment and tourism shocks (IMF, 2025b; World Bank, 2021).

Gross fixed capital formation has increased (21–33% of GDP), reflecting sustained infrastructure development. FDI remains high (~8–11% of GDP; US$3.6–4.4 billion/year), shaping coastal logistics and industrial estates. The Coastal Provinces Master Plan outlines 141 projects (~US$20 billion over 15 years) in transport, municipal services, social development and ecological restoration, positioning the coast as a competitive investment and tourism corridor.

6.2.1.2 Sustainable Financing Initiatives

Cambodia is strengthening enabling conditions for blue/green finance through sustainable finance principles, a developing taxonomy, and bond guarantees that could mobilize private capital for wastewater, solid waste, NbS, and greener ports (ABC, 2019; Green Finance Platform, 2019; CGCC, 2024). The Cambodia Sustainable Finance Principles (2019), endorsed by the Association of Banks in Cambodia and NBC, guide lenders on ESG, while the NBC–IFC Green/Sustainable Finance Taxonomy (initiated in 2023) is being developed with a 2024–25 roadmap to classify blue/green assets (CSFP; NBC–IFC). The CGCC Bond Guarantee Framework (2024) can also de-risk corporate (including sustainability-labelled) bonds, complementing UN-ESCAP/SERC/GGGI support via the Cambodia Sustainable Bond Accelerator (CGCC; UN-ESCAP). However, public financing remains limited and skewed: fisheries conservation budgets rose (DFC from US$150,000 in 2013 to US$440,000 in 2020) but ~85% still targets freshwater and only ~15% supports coastal/marine priorities (World Bank, 2021). NPASMP 2017–2031 estimated US$46.8 million for its first five years, yet biodiversity spending is ~0.18% of the central budget, highlighting chronic under-financing of marine conservation and enforcement (World Bank, 2021).

6.2.1.3 Public–private partnerships (PPP)

On infrastructure, the **PPP Law (2021)** established standard procedures and a **Viability Gap Fund (VGF)**. Active pipelines feature **12 solicited** (e.g., Sihanoukville Logistics Complex; Kampot International Tourism Port) and **7 unsolicited** projects (e.g., Phnom Penh–Sihanoukville Expressway; Funan Techo Canal), several of direct relevance to coastal systems and port capacity (RGC/MEF, 2021; GDPPP, 2025). See Annex Table 6-3 for more detail.

6.2.1.4 Poverty context

The national poverty rate fell from **47.8% (2007)** to **13.5% (2014)** (World Bank, 2014; PEAMSEA MoE, 2019). Through the next decade, monetary poverty declined from **33.8% (2009)** to **17.8% (2019/20),** but COVID-19 likely added **~2.8 percentage points**, exposing the fragility of near-poor, informal and tourism-reliant households—including in coastal provinces (Karamba & Tong, 2022). Emergency cash transfers via **IDPoor** softened the shock and prevented further slippage (World Bank, 2022).

6.2.2 Institutional Setting

6.2.2.1 National Coordination (ICZM)

The National Committee on Coastal Area Management and Development (NCCMD), established in 2012 and chaired by MLMUPC, is the government's primary ICZM coordination body. Its mandate is to guide coastal development and improve inter-ministerial coordination for sustainable management, conservation and local livelihoods. In practice, its authority has focused on coastal lands, with limited reach over marine waters and fisheries. A draft sub-decree aims to extend NCCMD's mandate to the full marine space and formalize coordination with the National Committee for Maritime Security (NCMS), reducing fragmented sea-use decisions as port, tourism and aquaculture investments expand.

The National Council for Sustainable Development (NCSD) provides the **horizontal policy umbrella** for sustainability, climate and circular economy across government. It is mandated to prepare, coordinate and monitor policies, strategies, legal instruments and plans, and to **report internationally** on Cambodia's commitments (NCSD, **2015**). NCSD is the natural locus for aligning climate (CCCSP 2024–2033; NDC 3.0) with marine governance once the NCCMD sub-decree is issued.

6.2.2.2 Line ministries and competent authorities

MLMUPC: Chairs NCCMD; leads land policy, spatial/urban planning and construction—critical to coastal setback, reclamation control and settlement planning (World Bank, **2021**).

MoE – Department of Coastal Zone and Marine Conservation (DCZMC): Established in 2016 to drive marine/coastal conservation and ICM implementation, and to apply the Code on Environment and Natural Resources (EIA, participation, compliance) to coastal projects (World Bank, 2021).

MAFF – Fisheries Administration (FiA): Statutory authority for marine and inland fisheries; sets and enforces harvest rules, establishes MFMAs, and runs catch monitoring. The Department of Fisheries Conservation (DFC) leads coastal conservation/ enforcement (World Bank, 2021).

MPWT: Through the Merchant Marine Department and the General Department of Waterway–Maritime Transport and Port, regulates ports, shipping and waterways; is Cambodia's main counterpart to the IMO on maritime safety and pollution control (World Bank, 2021; IMO, 2025).

MME: Leads hydrocarbons/mining policy and licensing, including any offshore oil & gas elements (World Bank, **2021**).

MoT: Plans and promotes coastal tourism, infrastructure standards and destination management; an anchor player for marine-based livelihoods and visitor pressure management (World Bank, **2021**).

6.2.2.3 Sub-national arrangements

Provincial Committee for Coastal Management and Development (PCCMDs): Each coastal province (Kampot, Kep, Preah Sihanouk, Koh Kong) has a PCCMD, chaired by the governor and comprising departmental and district decision-makers. They serve as NCCMD's arms for screening and coordinating coastal development, environmental protection and donor alignment at the provincial scale (World Bank, 2021).

6.2.2.4 Emergency preparedness and oil spill governance

A sub-decree and a national contingency plan for national oil spill preparedness and response are drafted but not promulgated, creating a response gap for major spills in the Gulf of Thailand (ITOPF, 2019). Interim reliance is on operator/port plans and regional arrangements (ASEAN OSRAP; Gulf of Thailand cooperation). Making the national plan legally effective—with a sensitivity atlas, tiered equipment, command system, and funding/levies—is a high-impact, near-term governance fix (ITOPF, 2019).

6.2.2.5 Regional and International cooperation

Because many coastal and marine challenges are transboundary, Cambodia actively participates in regional cooperation mechanisms.

COBSEA and ASEAN: Cambodia engages in COBSEA initiatives on marine litter, pollution and habitat protection (RAP-MALI; Marine & Coastal Ecosystems Framework), supporting learning on EPR, port-reception and litter monitoring (UNEP/COBSEA, 2019; 2023). Through ASEAN, Cambodia also cooperates on fisheries, biodiversity and disaster risk reduction.

PEMSEA: Through PEMSEA, Cambodia has produced State of the Coasts reports and applied Integrated Coastal Management (ICM) in Sihanoukville. ICM now covers the entire 435 km coastline—an important process milestone that requires consolidation through MSP and stronger enforcement finance (PEMSEA, 2024).

Bilateral cooperation: Cambodia maintains agreements and dialogue with Viet Nam and Thailand on fisheries and pollution control. Joint patrols against IUU fishing occur intermittently but need formalization and more consistent implementation.

Global initiatives: Cambodia contributes to SDG 14 and the Kunming–Montreal Global Biodiversity Framework (30×30), aligning national actions with global ocean and biodiversity commitments.

IMO/MARPOL: Cambodia is an IMO Member State; the priority is translating this into effective port-state control and port compliance (IMO, 2025).

6.2.3 Legal and Policy Setting

Cambodia's coastal–marine governance sits on a wide base of multilateral environmental agreements, complemented by regional cooperation platforms and an evolving domestic legal framework. See Annex Table 6-6 for the summary of the Cambodia's coastal related legal and policy frameworks.

6.2.3.1 International conventions and agreements

Cambodia is party to the major chemicals, biodiversity, climate, and wetlands conventions that shape coastal and marine management. Ratification of the **Basel (2001)**, **Rotterdam (2013)**, and **Stockholm (2006)** Conventions provides the legal basis to regulate hazardous waste, control trade in dangerous chemicals, and phase out POPs—key for estuarine water quality, mangrove health, and seafood safety.

In biodiversity, Cambodia participates in **CITES (1997)** and the **Convention on Biological Diversity (1995)**, enabling trade controls for listed marine species (e.g., sharks, seahorses) and requiring national strategies and reporting for reefs, seagrass, and coastal wetlands.

For climate, Cambodia is party to the **UNFCCC (1995)**, **Kyoto Protocol (2002)**, and **Paris Agreement (2017)**, framing mitigation/adaptation duties, access to climate finance, and justification for coastal resilience investments (e.g., NbS, wastewater upgrades, storm-surge protection).

Wetlands protection is anchored in the **Ramsar Convention (1999)**, with Koh Kapik & Associated Islets providing a long-standing legal basis for mangrove restoration, nursery protection, and community-based estuarine management.

International engagement has deepened with Cambodia's signature and September 2025 ratification of the **BBNJ ("High Seas")** Treaty, committing to area-based tools, EIA, monitoring, and benefit-sharing beyond national jurisdiction. Conversely, **UNCLOS** remains unratified—an enduring governance gap as clarity on maritime zones, rights, and cooperation mechanisms still depends on its accession.

6.2.3.2 Regional agreements and cooperation

PEMSEA (SDS-SEA & ICM): Supports mainstreaming of marine-pollution control, biodiversity conservation and climate action across the 435-km coastline, and provides peer review for MSP and monitoring (PEMSEA, 2023; 2024).

COBSEA (RAP-MALI & Marine & Coastal Ecosystems Framework): Guides policy coherence on plastics, habitat protection, data and financing under regional strategic directions (UNEP/COBSEA, 2019; 2023).

Maritime-risk cooperation: Cambodia participates in Gulf of Thailand arrangements and the ASEAN MoU on Joint Oil Spill Preparedness and Response (2014), a key mechanism as tanker and port traffic grows along the Sihanoukville corridor (ASEAN, 2014; ITOPF, 2019; IMO, 2023).

6.2.3.3 National laws and regulations

The **Code on Environment and Natural Resources (2023)** modernizes Cambodia's environmental governance by consolidating EIA/SEA, access to information and participation, compliance, and enforcement—thereby strengthening the enabling environment for marine and coastal regulation across sectors (MoE, 2023).

Sectoral pillars include the **Law on Fisheries** (2006, with subsequent amendments and implementing prakas) that enables community fisheries and the declaration of **Marine Fisheries Management Areas (MFMAs)**; the **Protected Areas Law** (2008) with zoning procedures used in coastal parks; the **Law on Water Resources Management** (2007); the **Forestry Law** (2002); and the **Land Law** (2001), all shaping land–sea interactions such as shoreline tenure, concessions, watershed sediment and pollution control (UNODC/SHERLOC, 2006; CDC, 2008; ODC, 2001–2008).

Royal Decrees establish key coordination bodies: the **National Committee on Coastal Area Management and Development (NCCMD)** for coastal planning/ICM, and the **National Council for Sustainable Development (NCSD)** for cross-government sustainability oversight and international reporting (Royal Decree—NCCMD, 2012; Royal Decree—NCSD, 2015). **Sub-decrees** operationalize site-level administration and conservation (e.g., **Peam Krasop Wildlife Sanctuary** zonation; **Organization and Functioning of the NCCMD Secretariat**) (RGC, 2011; RGC, 2012).

6.2.3.4 Marine/coastal management instruments

Cambodia has advanced a mixed protected-area/EAFM model. The **Koh Rong Archipelago MFMA** (Prakas No. 364, 2016) created the first large co-managed marine area; the **Koh Rong Marine National Park (MNP)** (Sub-Decree No. 14, 2018; **52,498 ha**) gives national-park status over the same island group; Kep's **Koh Po–Koh Tonsay MFMA** (2018) and **Prek Kampong Smach MFMA** (2022) extend the network to additional habitats and landing areas (FiA/MAFF, 2016; MoE, 2018; FiA/MAFF, 2018; FiA/MAFF, 2022). Proposed designations (**Koh Sdach MFMA**, **Kampot MFMA**) and the concept for **Koh Kong Krao MNP** are in the pipeline, but require formalization, sustained budgets, patrol capacity, and monitoring to reach ecological effectiveness (World Bank, 2021; FFI, 2024).

6.2.3.5 Policy strategies, plans and circulars

Strategic instruments provide the main framework for implementation. The **National Protected Area Strategic Management Plan (2017–2031)**, the Fisheries Strategic Planning Framework (2015–2024), and the **Sea Turtle Action Plan (2016–2026)** set targets for conservation, CFis, value chains and by-catch mitigation (MoE, 2017; MAFF/FiA, 2015; 2017). **Circular No. 01 on Coastal Development (2012)** offers useful planning principles but remains weak on enforcement (World Bank, 2021).

Forward-looking policy is guided by the **Circular Strategy on Environment 2023–2028** and the Climate Change Strategic Plan 2024–2033, both aligned with **NDC 3.0** to mainstream climate resilience, circular economy measures and coastal adaptation (NCSD, 2023; 2024).

Marine planning and risk management are advancing but incomplete. A draft **Marine Spatial Plan for the EEZ** appears in national/regional documents, and draft oil-spill arrangements—including a dispersant policy—have been prepared with IMO/PEMSEA support but are still awaiting formal adoption (PEMSEA, 2018; IMO, 2023; World Bank, 2021).

For pollution control, Cambodia relies on key sub-decrees on **Water Pollution Control (Sub-Decree No. 27/1999)** and **Solid Waste Management (Sub-Decree No. 113/2015)**, which establish discharge standards, licensing requirements and core obligations for waste generators. These are complemented by more recent policy instruments, including the **National Policy on Waste Management (2018)** and the **National Action Plan for Marine Plastic Waste Management (2023–2030)**.

6.2.3.6 Data systems, monitoring, and SDG indicators

Implementation capacity has been boosted by **FiA's monthly marine catch monitoring** at landing sites since **2021**, generating CPUE, effort, species, and value statistics for Kampot, Kep, Koh Kong, and Preah Sihanouk; these data are already informing MFMA zoning and EAFM pilots (FiA, 2023). Progress against global indicators includes **SDG 14.6.1** on instruments to combat IUU fishing (FAO scoring and narratives) and **SDG 14.2.1** on ecosystem-based approaches, which Cambodia evidences through its MFMA/PA/ICM portfolio (FAO, 2024; UN Statistics Division, 2020).

6.2.4 Civil society, stakeholders, and participation

6.2.4.1 NGO Co-management, Programs, and financing pipelines

A dense network of conservation NGOs supports day-to-day marine co-management in Cambodia. FFI, MCC, WEA, and WCS assist with MFMA zoning, joint patrols, ecological surveys, and habitat restoration, and evidence from Koh Rong suggests NGO-supported patrols and community engagement improve compliance compared with less-supported sites (FFI, 2020; MCC, 2022). These organizations also translate science into practical rules and help CFis/CPAs apply sanctions and procedures (FFI, 2020; WCS, 2023). Implementation is reinforced by major multi-year investments, including CAPFISH (EU–FAO/UNIDO, 2019–; ~US$18.96 million capture component) to improve post-harvest value chains, hygiene, and legality (FAO, 2024); GoTFish (GEF, 2023–2028) to support ecosystem-approach fisheries management and shared stock assessments in the Gulf of Thailand (GEF, 2023); CamAdapt (FAO/GEF–MAFF–MoE, 2022–2027) to fund adaptation, livelihood diversification, and risk-informed coastal planning (FAO, 2022); and the ADB Sustainable Coastal & Marine Fisheries Project (2023–) to upgrade landing sites, cold chain, and community-based management (ADB, 2023). Complementary efforts include wildlife-crime control (WCS–EU, 2019–2022) and site-based conservation by IUCN (2021–2025), MCC (2016–ongoing), and WEA (2016–ongoing).

6.2.4.2 Community institutions and legal empowerment

CFis and CPAs are the core legal structures for coastal co-management, with assemblies, elected committees and by-laws governing gear, access and habitat protection. While participation rights are strong on paper, capacity varies—committee turnover, bookkeeping challenges and uneven sanction follow-through are common (ODC, 2022; ClientEarth, 2020). Sites receiving NGO support—for transparent budgeting, public posting of accounts and women/youth sub-committees—show higher compliance and patrol performance (ADB, 2023; World Bank, 2021).

6.2.4.3 Participatory monitoring and data systems

SMART patrols and Kobo-based catch/incident logs are widely used in NGO-supported areas and increasingly linked with FiA's landing-site monitoring (CPUE/effort/species/value) to justify closures, gear limits and new no-take zones (FiA, 2023). Time-series evidence has shifted PCCMD/FiA discussions from anecdote to data (FAO, 2025). Academic partners (RUA, RUPP) provide ecological/socio-economic surveys and student training that feed into these monitoring systems (RUA, 2024; RUPP, 2024).

6.2.4.4 Public mobilization and campaigns

Plastic-reduction and clean-up campaigns**—*"Today, I Do Not Use Plastic (Bags)"*** and ***"Clean Cambodia, Khmer Can Do!"***—mobilized more than 10 million participants by 2024–2025, with visible declines in plastic-bag use and expanded coastal clean-ups (MoE, 2023; Phnom Penh Post, 2024; Cambodianess, 2024). Youth-led initiatives further reinforce readiness for upstream measures such as EPR and port-reception requirements (UN-PAGE, 2025).

6.2.4.5 Private sector and market levers

Hotels, dive operators, seafood buyers and ports are increasingly involved in beach cleans, mooring codes, gear-swap schemes and steps toward environmental management systems at PPAP and PAS (PEMSEA, 2024; World Bank, 2021). Buyer requirements for legality and traceability—strengthened through CAPFISH and ADB programmes—serve as effective levers for aligning fishing practices with MFMA rules (FAO, 2024; ADB, 2023).

6.2.4.6 Gaps and opportunities

Despite strong NGO–community engagement and new financing, three structural gaps still constrain effective coastal co-management in Cambodia. Table 6-2 below presents each gap with a concrete, near-term opportunity, and suggested leads.

Table 6-2 Stakeholders and partnerships: gaps and opportunities for coastal co-management

Structural gap	Evidence & implications	Practical opportunity / action	Suggested lead actors
Unpredictable financing for community patrols and restoration O&M	Patrol intensity and restoration upkeep drop when project grants lapse; sub-national budgets are thin and	Establish a pooled **Coastal Co-management Fund** that disburses against MFMA compliance indicators (patrol days, violation follow-up,	MAFF/FiA, MoE (DCZMC/PA), MEF (Budget/Trust Fund), PCCMDs; NGO partners

after projects end	irregular, risking backsliding on MFMA compliance and habitat gains.	habitat maintenance), fed by CAPFISH/ADB counterpart funds, blue philanthropy, and private levies.	(FFI, MCC, WEA, WCS)
Weak integration of citizen/NGO data into official statistics and decisions	SMART/Kobo patrol logs and community catch notes inform local action but are inconsistently ingested into FiA bulletins or zoning reviews; missed chance to make rules adaptive.	Create formal **data pipelines** and QA protocols from SMART/Kobo → FiA landing-site system (CPUE/effort/species) and MoE PA/MFMA dashboards; standardize meta-data and feedback loops to PCCMDs.	FiA (Statistics/DFC), MoE (DCZMC/PA), NGO data hubs; RUPP/RUA for QA/training
Limited, trusted grievance & benefit-sharing mechanisms for ports/tourism impacts	Conflicts over moorings, wakes, litter, or access persist; communities perceive uneven benefit capture, undermining rule legitimacy.	Codify **clean-marina/harbour protocols** (waste reception, no-discharge, mooring codes) and set up **grievance/benefit-sharing charters** at priority sites; align with RAP-MALI and port EMS upgrades.	MPWT (Ports), MoT, PCCMDs, port operators, municipal councils; PEMSEA/COBSEA for standards

Source: *World Bank 2021; ADB, 2023; FAO 2024, 2025; FiA, 2023; FFI, 2020; PEMSEA, 2024; GEF, 2023.*

6.2.5 Governance Performance and Effectiveness

IWRM & transboundary cooperation. Cambodia's latest SDG 6 dashboard (Figure 6-1) shows **medium–high** implementation of Integrated Water Resources Management—**62% in 2023** across the four dimensions (enabling environment, institutions/participation, management instruments, financing), increased from 46% in 2017. This reflects solid frameworks but continuing **financing and sub-national capacity gaps**, especially for routine monitoring and compliance (UN-Water SDG 6 Data Portal, 2023).

Figure 6-1 Degree of integrated water resources management implementation (0-100) in Cambodia, progress over time, by dimension (DSG 6.5.1)

For SDG **6.5.2**, Figure 6-2 indicates that Cambodia reports **near-complete operational arrangements (98%)** for surface transboundary waters via Mekong cooperation mechanisms, indicating strong formal cooperation even as data interoperability and joint pollution control can be strengthened (UNECE/UN-Water, 2023).

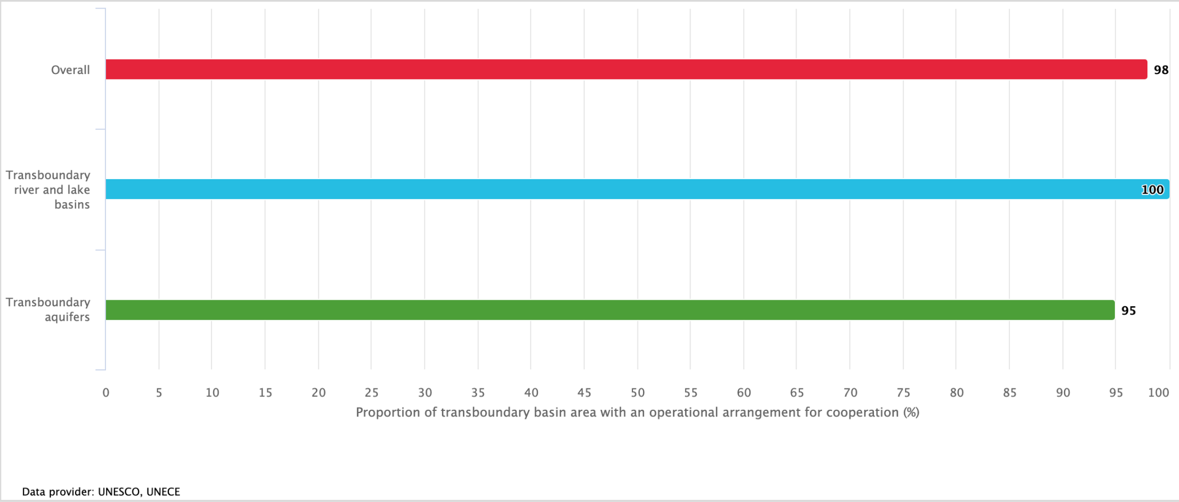


Figure 6-2 Proportion of transboundary basin area with an operational arrangement for water cooperation in Cambodia, progress over time, by component (DSG 6.5.2)

Marine protection and compliance: Cambodia's marine estate is centred on the Koh Rong MFMA (2016), Koh Rong MNP (2018) and key Ramsar/PA sites such as Koh Kapik and Peam Krasop. METT scores show gradual improvement, but effective coverage remains limited by gaps in patrol assets, prosecution follow-through and O&M budgets. FiA's monthly catch monitoring (since 2021) provides essential CPUE/effort/species/value data for EAFM, while participation in COBSEA's RAP-MALI improves policy coherence on marine litter, though port-reception and EPR pilots remain inconsistent.

Financing and instrument deployment: Institutions (NCSD/NCCMD/PCCMDs) and major programs (CAPFISH, ADB coastal fisheries, GoTFish, CamAdapt) provide important support, but operational budgets lag behind mandates. Conservation funding has grown but remains weighted toward freshwater; coastal enforcement and lab O&M remain under-resourced. Sites with strong NGO–community co-management perform better, but scaling requires predictable domestic finance, streamlined sanctioning and integrated data systems.

International environmental and governance benchmarks: Cambodia's 2024 Environmental Performance Index (EPI) ranks the country around 170th of 180, with a score of ~31, placing it in the lowest global tier (EPI, 2024). The World Bank Worldwide Governance Indicators (WGI) also point to systemic constraints: Government Effectiveness remains in the 10–13th percentile, Regulatory Quality in the 15–20th percentile, and Control of Corruption in the 5–10th percentile (WGI, 2024). These limitations affect the consistency of ICZM/MSP implementation, enforcement, and transparent decision-making in coastal development**.** See Annex 6-2 for more detail and explanatory notes.

6.3 Discussion and Conclusions

6.3.1 Risk assessment: Current governance capacity to engage stakeholders, reduce ecosystem stresses, improve/protect ecosystems, achieve socially just outcomes, and improve well-being

6.3.1.1 Governance Assessment

Cambodia's coastal–marine governance system is broadly established and increasingly participatory. National bodies (NCSD, NCCMD), sector ministries, provincial PCCMDs and community institutions (CFis/CPAs) are reinforced by strong NGO co-management (FFI, MCC, WEA, WCS). This aligns with the TDA–SAP distinction between *good governance* (institutions and participation) and *effective governance* (implementation and behaviour change). Using the Transboundary Waters Assessment Programme (TWGAP) Governance Architecture Assessment Framework, effectiveness is assessed against four outcome categories, as following:

a) Stakeholder engagement and compliance

Co-management arrangements supported by NGOs have increased patrol days, zoning, and community reporting in MFMA and MPA sites, in line with TWGAF's expectation that behaviour change is a precursor to stress reduction. CFis and CPAs provide formal spaces for local voice in rule-making and implementation, while PCCMDs offer a platform for inter-agency coordination at provincial level. However, the depth and consistency of engagement vary by site, depending heavily on project presence and NGO support.

b) Reduced stresses

The expansion of MFMAs and the Koh Rong MNP, together with FiA's landing-site monitoring of CPUE, effort, species and value since 2021, provides a foundation for ecosystem-based fisheries management. In MFMA sites, joint patrols, community reporting, no-take zones and gear rules are applied more consistently than in unmanaged areas. National anti-plastic campaigns have reduced plastic-bag use, and IWRM implementation reached 62% in 2023, with 98% of transboundary basin area under cooperation—signals of maturing water and pollution governance. However, wastewater and solid-waste services remain limited, and at-sea enforcement and monitoring continue to face chronic O&M budget constraints.

c) Improved ecosystems

Management Effectiveness Tracking Tool (METT) reviews for Koh Rong demonstrate stepwise gains in management performance and the roll-out of restoration pilots for seagrass and coral, and the MFMA network has expanded to Kep (2018) and Prek Kampong Smach (2022). Nonetheless, system-wide ecological recovery is still partial. Effective coverage of MPAs/MFMAs remains modest relative to the scale of pressures, prosecution follow-through is inconsistent, and proposed areas (Koh Sdach and Kampot MFMAs; Koh Kong Krao MNP concept) still require formal designation, adequate budgets, and sustained patrol capacity to achieve ecological objectives (World Bank, 2021; FFI, 2024).

d) Socially just solutions

Cambodia's co-management laws recognise CFis/CPAs with defined access and decision-making rights, and programmes such as CAPFISH, the ADB Sustainable Coastal & Marine Fisheries Project, and CamAdapt support livelihoods, hygiene/traceability, and climate resilience. TWGAF, however, stresses that equity must be demonstrated, not assumed. Evidence points to uneven grievance handling and benefit-sharing in tourism and port developments, with needs for stronger gender-responsive livelihood support, transparent revenue-sharing, and accessible complaint mechanisms to sustain compliance incentives (FAO, 2024; ADB, 2023; ClientEarth, 2020).

e) Improved well-being

Poverty fell sharply pre-COVID (47.8% to 13.5% between 2007–2014; 33.8% → 17.8% between 2009–2019/20), yet the pandemic added ~2.8 percentage points, hitting tourism-dependent coastal areas hardest (World Bank, 2014; Karamba & Tong, 2022). IDPoor cash transfers cushioned impacts, but many coastal households remain vulnerable to fish-price volatility, climate hazards, and tourism cycles. Meanwhile, large-scale anti-plastic and clean-up campaigns (10–11 million participants) indicate strong public readiness for upstream pollution reforms that can enhance coastal health, livelihoods, and tourism prospects (MoE, 2023; UN-PAGE, 2025).

As part of the TWAP of LMEs in 2017 an assessment of transboundary governance architecture for the SCS and GoT LMEs was undertaken using the framework of completeness, integration and engagement (Table 6-3).

Table 6-3 TWAP Governance Architecture Assessment Framework

Risk Rank	Completeness Range	Integration Range	Engagement Range
Very Low	80-100%	0.8-1.0	80-100%
Low	60-80%	0.6 -0.8	60-80%
Medium	40-60%	0.4-0.6	40-60%
High	20-40%	0.2-0.4	20-40%
Very High	0-20%	0.0-0.2	0-20%

Source: *Fanning et al., 2017.*

A self-assessment for Cambodia, using the TWAP governance architecture framework (Fanning *et al* 2017), and drawing on the evidence and risk analysis presented above, was undertaken with the following results in Table 6-4 below:

Table 6-4 Cambodia's national governance architecture self-assessment

	Completeness	Integration	Engagement
Cambodia	55-60% (Medium-Low)	0.35-0.45 (High-Medium)	45-55% (Medium)

See *Annex 6-3 for more details and rational for Cambodia's TWAP Governance Scores*

6.3.1.6 Residual systematic risks

Cambodia's current governance capacity is **directionally strong but not yet sufficient** to fully deliver reduced stresses, resilient ecosystems, socially just outcomes and durable improvements in well-being. The main risks relate to:

(i) fragmented sea-use decisions pending adoption of the NCCMD marine sub-decree and operational marine spatial planning;

(ii) chronic under-financing of enforcement, monitoring, laboratories and O&M;

(iii) an incomplete national oil-spill preparedness system; and

(iv) pollution pressures—especially plastics and untreated wastewater—that continue to outpace local management capacity. Tackling these constraints is essential to move from well-designed frameworks to consistently effective coastal and marine governance.

6.3.2 Current governance capacity to respond to climate and major environmental changes, as well as population growth and demand

Cambodia's capacity to respond to climate change and rising environmental pressures is improving, with updated laws, monitoring systems and stronger regional cooperation. However, financing constraints, limited enforcement and incomplete marine planning continue to limit the shift from policy ambition to resilient, on-the-ground action.

6.3.2.1 Policy alignment and enabling instruments

Recent reforms provide a significantly stronger enabling environment for climate-responsive coastal management. The ***Code on Environment and Natural Resources*** *(2023)* consolidates EIA/SEA, compliance and access-to-information rules, while the *Circular Strategy for Environment (2023–2028)* and the *Cambodia Climate Change Strategic Plan 2024–2033*, aligned with *NDC 3.0*, commit the government to risk-informed planning, circular economy measures, and climate-adapted coastal development (NCSD, 2023; 2024). These instruments create a clearer policy pathway for integrating coastal resilience, wastewater management, mangrove restoration, and adaptation finance into national and provincial plans.

6.3.2.3 Marine-specific adaptive capacity

Adaptive capacity in marine systems has risen through (i) expansion of the MFMA/MPA network; (ii) FiA's standardized marine catch monitoring (since 2021) providing near-real-time CPUE, effort, species and value data; and (iii) Cambodia's engagement in COBSEA's RAP-MALI for marine-litter monitoring and upstream plastics reduction (FiA, 2023; UNEP/COBSEA, 2019–2024). These generate critical inputs for ecosystem-based and climate-responsive management. However, monitoring-to-action links remain weak. FiA landing-site data are not consistently used for stock assessments, adaptive harvest controls, or cumulative-impact thresholds under MSP. Enforcement across the MFMA/MPA system is limited—patrol effort, prosecution follow-through, and O&M budgets remain insufficient amid rising fishing effort and coastal development pressures.

6.3.2.4 Climate exposure and major environmental risks

Cambodia's coastal provinces face rising vulnerability to sea-level rise, storm surge, saline intrusion, and extreme rainfall events—pressures compounded by intensive port expansion, rapid tourism development, and growing urban wastewater loads (World Bank, 2021). The most acute readiness gap remains **oil-spill preparedness**: although a national contingency plan and dispersant policy have been drafted, they have not yet been formally adopted or funded. As tanker traffic and port throughput expand in Sihanoukville, this gap represents a critical shortfall in climate and disaster preparedness (IMO, 2023; ITOPF, 2019).

6.3.2.5 Population growth, economic expansion, and rising demand

Population growth, urbanization, and blue-economy investment are increasing pressures on coastal infrastructure, fisheries, and nearshore water quality. Coastal settlements continue to expand into hazard-prone areas; tourism hubs require rapidly increasing wastewater, solid-waste and port-reception capacities; and fishing effort intensity remains high despite declining CPUE for some nearshore species.

6.3.3 Strategies to enhance government responses to climate change and achieve sustainability of coastal and marine environments

a) Finalize and operationalize the foundational marine governance framework

Governance effectiveness requires a consistent, enforceable basis for marine decision-making. Priorities include adopting the NCCMD coastal and marine sub-decree to establish whole-of-sea coordination rules, clarify ministerial mandates, and formalize a national mechanism that aligns port development, fisheries management, conservation, aquaculture, and tourism. Marine Spatial Planning (MSP) for the EEZ should be operationalized through clear zoning, cumulative-impact thresholds, and integration of FiA monitoring with MoE EIA/SEA requirements. Domestic ratification of UNCLOS should anchor maritime zones and clarify obligations complementary to Cambodia's BBNJ ratification (2025), reducing fragmented sea-use decisions.

b) Scale effective MPAs/MFMAs and ecosystem-based fisheries management (EAFM)

MFMA and marine park coverage has expanded (e.g., Koh Rong, Kep, Prek Kampong Smach), but effectiveness remains constrained by limited budgets and enforcement capacity. Priorities include formalizing proposed MFMAs (Koh Sdach and Kampot) and advancing the Koh Kong Krao MNP concept, while securing sustained patrol and O&M financing through public budgets, trust funds, and blended finance (e.g., CAPFISH, ADB). SMART/Kobo monitoring should be embedded into adaptive EAFM controls—seasonal closures, gear limits, and no-take replenishment zones—and restoration pilots (seagrass, coral) scaled with livelihood support and tourism partnerships.

c) Implement pollution reduction and circular economy measures

Pollution continues to limit ecosystem recovery, requiring measures that reduce leakage at source and strengthen municipal systems. RAP MALI should be operationalized through national Extended Producer Responsibility (EPR) pilots for plastics, tourism packaging, and port-reception facilities, alongside stronger wastewater and solid-waste systems in coastal towns through green/blue bonds, PPPs, and municipal investment. Circular economy actions under the Circular Strategy for Environment (2023–2028) should be mainstreamed, building on strong social mobilization (10–11 million participants in clean-up campaigns). Port environmental management should be upgraded through no-discharge rules, oily-waste reception, and green logistics.

d) Strengthen risk management and oil-spill preparedness

Rising tanker traffic and port expansion in Sihanoukville increase the need for a fully functional national oil-spill system. Priorities include promulgating the National Oil Spill Contingency Plan and dispersant policies, establishing a national sensitivity atlas with tiered response capacity and equipment caches, and creating a dedicated financing mechanism using levies and joint industry arrangements. Port, fisheries, tourism, and protected-area authorities should conduct joint exercises under GI-SEA and Gulf of Thailand frameworks.

e) Finance the blue transition and resilience measures

Core functions—enforcement, O&M, laboratories, and monitoring—remain underfunded, requiring scaled and diversified finance. Options include sovereign or municipal blue/green bonds enabled by the Cambodian Sustainable Finance Principles and NBC–IFC taxonomy, and use of PPP Law (2021) tools, including the VGF, to finance resilient wastewater systems, green port infrastructure, mangrove buffers, and cold-chain upgrades. A Coastal Co-management Fund could disburse against MFMA compliance indicators, while climate-finance access expands through NDC pipelines and multi-donor trust funds.

f) Strengthen marine data systems, transparency, and evidence-based decision-making

Effective governance requires consistent use of credible data across agencies. Priorities include institutionalizing open marine data (CPUE, effort, species, bycatch, plastics, HABs) across FiA, MoE, NCCMD, and PCCMDs; integrating SMART/Kobo streams into FiA bulletins and MoE dashboards; and linking land–sea datasets within IWRM and MSP frameworks to guide hazard mapping, zoning, and policy cycles. Periodic review and evaluation, consistent with TWGAF and SDS-SEA guidance, should track governance improvement over time.

6.3.4 Recommended priority actions including regional cooperation

6.3.4.1 Near-term priorities (1–2 years)

a) Adopt core marine governance instruments

Cambodia should approve the NCCMD marine sub-decree, adopt and fund the National Oil Spill Contingency Plan, and launch national port-waste reception standards alongside enforceable no-discharge rules.

b) Strengthen fisheries management and enforcement

FiA and provincial authorities should scale catch-monitoring data into harvest-control pilots (e.g., Koh Kong, Kampot), while the Royal Government and partners should increase domestic support for CFi/CPA co-enforcement and patrols and resource no-take replenishment zones and targeted gear restrictions in priority MFMAs.

c) Reduce pollution pressures

Cambodia, municipalities, and the private sector should launch EPR pilots for plastics with COBSEA support, sustain national anti-plastic campaigns linked to municipal KPIs for waste reduction, and upgrade wastewater management for key coastal towns through PPPs and blue bonds.

d) Establish a Blue Public Investment Program (BPIP)

The Ministry of Economy and Finance, together with sector ministries, should package priority investments—Sihanoukville port decarbonization, coastal wastewater and sludge systems, mangrove restoration corridors, and cold-chain/landing-site modernization—using the PPP Law's VGF and CGCC guarantees.

6.3.4.2 Medium-term priorities (3–5 years)

a) Operationalize marine spatial planning

NCCMD, MoE, FiA/MAFF, and relevant ministries should finalize MSP zoning for the EEZ, integrate cumulative-impact thresholds and climate-risk layers, and harmonize MSP with tourism development, port master plans, and MFMA networks.

b) Expand and strengthen the MPA/MFMA system

MoE and FiA, with provincial administrations, should formalize Koh Sdach MFMA, Kampot MFMA, and Koh Kong Krao MNP; they should also ensure sustained O&M and patrol budgets and routine ecological monitoring, and embed community benefit-sharing agreements and accessible grievance mechanisms.

c) Strengthen climate adaptation systems

NCSD/MoE and subnational authorities should integrate NDC 3.0, CCCSP 2024–2033, and circular-economy commitments into provincial plans, expand nature-based solutions (mangroves, dunes, reefs) for coastal protection, and strengthen provincial disaster management systems and early-warning capacity.

6.3.4.3 Regional and transboundary cooperation

a) Strengthen Gulf of Thailand coordination

Cambodia, Viet Nam, and Thailand should conduct joint oil-spill exercises and share sensitivity mapping, strengthen transboundary stock assessments under GoTFish, and cooperate on marine-litter source reduction and monitoring (RAP-MALI).

c) Expand Mekong transboundary water governance

Cambodia and Mekong partners should improve joint water-quality monitoring and pollution data exchange, and align coastal hazard and watershed sediment management under SDG 6.5.2 frameworks.

c) Align with emerging global frameworks

Cambodia should prepare for BBNJ implementation (area-based management tools, EIAs, genetic-resource benefit-sharing), peer-review MSP and MPA expansion via PEMSEA's SDS-SEA mechanism, and coordinate with IMO to strengthen MARPOL implementation and port state control capacity.

6.4 Methodology and analysis

This section summarizes the framework, evidence base, and steps used to assess governance architecture, processes, participation, social justice, and effectiveness, drawing on TWAP, Mahon et al. (2017), and the National Governance TDA Guidance.

6.4.1 Analytical Framework

The assessment applied two complementary lenses: **good governance** (institutional arrangements, mandates, integration, transparency, and participation) and **effective governance** (stress reduction, ecosystem condition, social justice, and adaptation outcomes). Indicators were organized into five domains aligned with TWAP: **economic/policy drivers**, **institutional setting**, **legal/policy setting**, **stakeholders**, and **governance performance**.

6.4.2 Data Collection

Evidence was compiled from three streams. **Quantitative indicators** covered macroeconomic trends, sectoral finance, SDG 6.5.1/6.5.2, MFMA/MPA metrics, regional engagement, and co-management coverage. An **institutional and legal review** examined laws and decrees, project documents, NGO assessments, grievance cases, MSP drafts, and participation in MEAs. **Stakeholder evidence** drew on community and NGO patrol logs, provincial inputs, academic partner data, site observations, and compliance reviews of ports and operators.

6.4.3 Assessment Steps

The analysis: (1) classified indicators across the five governance domains; (2) reviewed governance architecture and processes, including mandates, integration, policy-cycle completeness, and adequacy of budgets, O&M, and enforcement; (3) assessed effectiveness using enforcement effort, stress-reduction signals, ecosystem proxies (e.g., CPUE, METT, restoration), and social-justice and well-being outcomes; and (4) evaluated regional alignment against SDS-SEA, RAP-MALI, ASEAN protocols, Gulf of Thailand cooperation, and emerging obligations under MARPOL and BBNJ.

6.4.4 Synthesis

The combined evidence identified key **strengths** (updated laws and institutions, growing monitoring capacity, and regional engagement), **weaknesses** (limited oil-spill readiness, chronic under-financing of enforcement/O&M, and incomplete MSP), **risks** (fragmented mandates and weak data–decision feedback loops), and **opportunities** (MSP expansion, EPR mechanisms, blue finance, and strengthened co-management funding).

7. Conclusion

The National Transboundary Diagnostic Analysis (TDA) for Cambodia provides the first integrated, indicator-based synthesis of **socioeconomic and climate conditions**, **pollution pressures**, **ecosystem status**, **fisheries trends**, and **governance capacity** across the country's coastal and marine systems. Drawing from the detailed analyses in Chapters 2–6, this chapter summarizes how far Cambodia has met the TDA objectives, identifies key cross-cutting conclusions, reviews spatial patterns of risk, and outlines the audiences and future directions for indicator-based coastal environmental assessments.

7.1 Meeting the TDA Objectives

The TDA set out to achieve five core objectives, and these objectives have now been substantively met.

Objective 1: Identify major transboundary environmental problems

Major problems clusters are clearly diagnosed: socioeconomic & livelihood risks, land-based pollution (nutrients, microbes, plastics, industrial contaminants), habitat loss, fisheries over-exploitation, climate-related salinization/flooding, and weak enforcement capacity are consistently identified across all chapters. Across all chapters, the TDA confirms 6 priority problem clusters.

Objective 2: Assess drivers and root causes

Drivers and root causes are traced across multiple, reinforcing pressures. Rapid coastal development, expanding agriculture and aquaculture, untreated wastewater, continued trawl fisheries, and fast urbanization shape the problem landscape, while incomplete mandates at sea and uneven enforcement capacity constrain effective responses. As discussed in Chapter 6, governance overlaps and persistent financing gaps further limit coordination and sustained implementation. These drivers are both economic—rising FDI and large investments in ports, tourism, and aquaculture—and institutional, including fragmented mandates and chronically low operating budgets. Coastal provinces now host more than **1.7 million people** and continue to grow at roughly **2.3–4.2% per year**, intensifying demand for land, services, and coastal infrastructure. Tourism expansion has been a major accelerator: arrivals exceeded **6 million** in 2019, with the strongest concentration in Preah Sihanouk, increasing wastewater loads and solid-waste leakage in nearshore corridors. Despite these mounting pressures, FiA's budget for marine conservation remains limited—approximately **US$150,000–440,000 per year** to cover more than 435 km of coastline—leaving gaps in patrol coverage, monitoring, compliance actions, and site-level management effectiveness.

Objective 3: Map spatial distribution of risks

Spatial hotspots are identified across Cambodia's coast and connected river–sea systems. Peam Krasop–Koh Kapik, Trapeang Ropov–Kampot Bay, the Kep–Ha Tien seagrass corridor, the Sihanoukville urban coastline, major river–sea discharge zones, and the Phnom Penh confluence are established as high-risk areas where pollution loads, habitat sensitivity, and livelihood exposure intersect. To substantiate these priority zones, the TDA incorporates spatial analyses that map **17 wastewater discharge hotspots**, delineate **six major sediment plumes**, and detect **five trawl-incursion clusters** that threaten nearshore habitats and fisheries productivity. The assessment also identifies **four high-dependence livelihood zones** where communities are most reliant on coastal ecosystems and therefore most vulnerable to degradation and shocks. Finally, it traces **three cross-border pollution**

pathways—Tonle Sap–Mekong–Bassac, Kep–Ha Tien, and Koh Kong–Trat—highlighting how upstream inputs and transboundary currents can concentrate impacts beyond administrative boundaries and reinforce the need for coordinated management responses.

Objective 4: Evaluate governance capacity

Governance capacity and gaps are assessed across the policy, institutional, and financing systems that underpin coastal and marine management. While integration frameworks such as ICZM and the coordinating roles of NCCMD and NCSD are in place, core constraints persist—particularly for offshore mandates, compliance and enforcement systems, and sustained financing—limiting the pace of ecosystem recovery. Governance capacity indicators presented in Chapter 6 show moderate progress on water-resources integration, with SDG 6.5.1 (IWRM implementation) assessed at **62%,** alongside very high reported coverage for SDG 6.5.2 (transboundary cooperation) at **98%**. Protected-area coverage is also significant, at approximately **44,000 ha of MPAs**, yet effective management lags behind designation: less than 30% is effectively patrolled, leaving gaps in deterrence, monitoring, and response. At the subnational level, provincial ICZM committees are functioning and active, but their ability to plan, coordinate, and implement priority actions is constrained by chronic underfunding, with average operating resources below **US$50,000 per year.**

Objective 5: Provide evidence for SAP

The evidence base is complete and ready to support SAP preparation. All required SAP elements have been fully developed, including problem trees that trace drivers and root causes, risk rankings that prioritize issues by severity and exposure, and clear socioeconomic linkages that connect environmental pressures to livelihoods and well-being. The assessment also includes institutional mapping to clarify mandates and coordination needs, sector diagnostics that identify constraints and opportunities across key industries, and a consolidated analysis of ecosystem–livelihood dependencies. Together, these components provide a coherent foundation for selecting priority actions, assigning responsibilities, and defining targeted interventions for implementation under the SAP.

7.2 Key Conclusions and Cross-Cutting Interactions

Cambodia's coastal–marine system is now shaped by a tight coupling of rapid economic change, persistent poverty, and livelihood dependence on natural resources, accelerating land-based pollution, and progressively weaker ecosystem functions. Climate change and governance gaps act as system-wide multipliers, amplifying risks and constraining the country's ability to manage trade-offs. The evidence from Chapters 2–6 points to seven overarching conclusions.

1. Converging pressures in fast-transforming coastal provinces

The four coastal provinces host more than 1.7 million people, with a poverty rate of **17.8%** (2019/20) and a large near-poor group whose incomes are highly sensitive to climate and economic shocks. Natural resource dependence remains high—particularly in Koh Kong, where wetland households derive **65–90%** of their income from local ecosystems—while Sihanoukville's economy is heavily reliant on tourism, exposing the province to external downturns and environmental degradation. Across all provinces, economic expansion is outpacing the capacity of environmental services and institutions to manage risks. Preah Sihanouk's urban footprint expanded by roughly 250% between 2010 and 2023, aquaculture in the Kep–Kampot corridor increased from around 500 ha in 2010 to more than 3,000 ha by 2024, and concessions and land-cover change in Koh Kong have driven sediment inflows to estuaries and nearshore waters upward by more than **35%.** These trends underpin a pattern where growth in tourism, real estate and aquaculture is not yet matched by wastewater, solid-waste and land-use controls, creating strong pressure on coastal ecosystems and communities.

2. Land-based pollution as the fastest intensifying threat

Land-based pollution is the most rapidly worsening driver of coastal degradation. Coastal wastewater treatment remains extremely limited—capturing **<20%** of sewage in Preah Sihanouk, **<10%** in Kampot, and almost none in Koh Kong and Kep. Fecal coliform levels in bathing waters and landing sites frequently reach **10^4–10^5 CFU/100 mL**, while industrial effluents commonly exceed national limits for oil and grease, lead and zinc. River–coast transition zones commonly show BOD levels of **6–12 mg/L**, exceeding the ASEAN guideline range of **2–3 mg/L**, while TN/TP loads in major estuaries are estimated to have risen by **40–70%** since 2010. Solid waste and plastics compound these pressures: plastic leakage is estimated at more than **85,000 tonnes per year**, while only 1**0–12% of waste is recycled**, largely PET and metal streams. Because pollution hotspots coincide with tourism nodes, fishing grounds and mangrove/seagrass habitats, land-based pollution acts as a cross-cutting threat that undermines public health, ecosystem resilience and economic competitiveness.

3. Ecosystem degradation reducing fisheries productivity

Mangroves, seagrass meadows and coral reefs continue to contract or degrade, eroding both fisheries productivity and natural coastal protection. Available evidence indicates mangrove losses of roughly **3,500–4,000 ha** since 2014, concentrated in Koh Kong and parts of Preah Sihanouk. Seagrass meadows in Kampot–Kep are estimated to have declined by around 20% since 2010, driven by turbidity, trawling impacts, and coastal construction. Coral cover at many nearshore sites has fallen to approximately 6–10%, while healthier but still stressed offshore reefs are typically reported at 20–30% cover. Globally and regionally, mangroves are estimated to support roughly **60%** of coastal fisheries biomass, while seagrass meadows provide nursery habitat for at least **13 key commercial species**. The combined loss of mangroves, seagrass and coral is estimated to reduce juvenile survival by **20–40%**, weaken the coastline's ability to buffer storms and erosion, and diminish blue-carbon storage potential—thereby linking biodiversity loss directly with climate mitigation and food security.

4. Overfishing and trophic collapse

Fisheries indicators show long-term systemic stress: marine CPUE has collapsed from more than 170 kg/hour in the 1960s to around 26 kg/hour today, accompanied by a downward shift in the Mean Trophic Index toward smaller, lower-value species. This reflects both overfishing and loss of higher-trophic predators, signaling trophic simplification. Exploitation rates for many demersal species are commonly reported in the range of **0.65–0.80**, consistent with overfished stocks, while high-value groups such as groupers and snappers have declined by more than **50%** compared with the early 2000s. Small pelagics now account for more than **70%** of marine catches, signaling reduced ecosystem complexity and lower economic value per unit catch. This trophic simplification reflects the combined effects of high fishing pressure, habitat loss, weak enforcement, and limited alternative livelihoods. It also reduces the economic value and nutritional quality of the catch, deepening vulnerability for coastal communities.

5. Climate change as a system-wide amplifier

Climate change does not act as a separate problem, but as a force that amplifies existing pollution, habitat and livelihood stresses. Projections indicate **+11–20 cm** of sea-level rise by 2050, with documented salinity intrusion advancing **5–7 km** inland in Kampot during dry seasons and affecting rice fields, drinking water and aquaculture. Between 2020–2022, extreme rainfall and floods affected more than **200,000 people** in coastal provinces. Sea-surface temperature anomalies reached **+0.8–1.1 °C** above baseline in 2023, increasing risks of coral bleaching and fish mortality events. Composite indices suggest coastal provinces already rank high in climate vulnerability—Kampot (0.53), Kep (0.55), Koh Kong (0.56), and Preah Sihanouk (0.60)—and sea-level rise threatens more than 35,000 ha of coastal settlements and rice fields. Climate change thus intensifies exposure (through higher floods, erosion, saline intrusion) and sensitivity (through degraded ecosystems and pollution), while adaptive capacity remains uneven and under-resourced.

6. Governance and limited enforcement

Although the policy framework has strengthened, implementation capacity and coordination remain partial. The draft mandate of the **NCCMD** for marine and coastal management is still pending, leaving offshore jurisdiction and cross-sector coordination under-defined. The national oil spill contingency plan is prepared but not yet fully operational. Operational indicators illustrate persistent gaps, including limited monitoring and enforcement of EIA conditions (estimated at only 60–70% in practice), inadequate patrol coverage (less than 20% of the required marine area is regularly covered by patrol assets), and inconsistent compliance with effluent standards (only around 25–30% of industrial and tourism facilities consistently meet requirements). Among MFMAs, Koh Rong is the clearest example approaching full zoning, management planning, and community engagement, while other sites remain under-resourced. Financing constraints reinforce these weaknesses: the FiA marine budget has fluctuated between **US$150,000 and 440,000 per year**, limiting sustained enforcement, monitoring, and co-management support. Collectively, these governance gaps slow progress toward fully functional ICZM, marine spatial planning, and effective pollution control at the scale required for recovery.

Table 7-1 Summary of key problem clusters and indicators of Cambodia TDA

Problem Cluster	Indicator / Evidence	Magnitude / Quantitative Value
Socioeconomic & Livelihood Risks	Coastal population	>1.7 million people in the 4 coastal provinces
	Poverty & vulnerability	Poverty 17.8% (2019/20); large near-poor group highly exposed to shocks
	Ecosystem-based livelihoods	Koh Kong wetland households derive **65–90%** of income from wetlands
	Tourism reliance	Extremely high in Sihanoukville; economy highly sensitive to external shocks and environmental degradation
Climate-Related Coastal Risks	Sea-level rise	Projected **+11–20 cm** by 2050, threatening >**35,000 ha** of coastal settlements and rice fields
	Flood impacts	**>200,000 people** affected by coastal and riverine floods (2020–2022)
	Sea-surface temperature anomaly	**+0.8–1.1 °C** above baseline in 2023, increasing bleaching and mortality risks
Land-Based Pollution	Coastal wastewater treatment coverage	Preah Sihanouk **<20%**, Kampot **<10%**, Koh Kong & Kep ≈ **0%** treated
	Fecal coliform concentrations	**10^4–10^5 CFU/100 mL**, exceeding ASEAN bathing-water thresholds
	Industrial effluent exceedances	Oil & grease **12 mg/L** (limit **5 mg/L**); Pb **0.25 mg/L** (limit **0.1 mg/L**); Zn **1.1 mg/L** (limit **1.0 mg/L**)
	Plastic leakage rate	**>85,000 tonnes/year**; national recycling rate **10–12%**
	Nutrient loads (TN/TP)	**+40–70%** increase (2010–2023) in key estuaries and river–coast interfaces

Habitat Degradation	Mangrove loss	Loss of **3,500–4,000 ha** since 2014; highest degradation in Koh Kong
	Seagrass decline	Kampot–Kep meadows reduced by **~20%** since 2010
	Coral reef condition	Nearshore coral cover **6–10%**; offshore reefs **20–30%**
	Salinity intrusion	Dry-season intrusion **5–7 km** inland in Kampot, affecting rice fields and water supply
Fisheries Decline & Trophic Downgrading	Marine CPUE trend	Decline from **>170 kg/hour** (1960s) to **~26 kg/hour** in recent years
	Catch composition shift	High-value demersal species down **>50%**; low-value/small pelagics now **>70%** of catch
	Exploitation rate (E)	**0.65–0.80** for many demersal species → overfished
	Mean Trophic Index (MTI)	Declining, indicating progressive food-web simplification and loss of apex predators
Governance Gaps	NCCMD marine mandate	Draft mandate pending; offshore authority and cross-sector coordination not yet fully formalised
	Oil spill preparedness	National contingency plan drafted but not operational at full scale
	EIA compliance	Only **60–70%** of EIA conditions are monitored and/or enforced
	Marine enforcement coverage	Existing patrol assets cover **<20%** of the required marine area
	Fisheries conservation financing	FiA marine budget roughly **US$150,000–440,000/year**, limiting sustained enforcement and co-management

This evidence base underlines that Cambodia's coastal challenges are not isolated sector issues, but interconnected dynamics that require integrated, climate-aware, and equity-focused responses in the subsequent SAP and investment planning.

7. Cross-sectoral feedback loops intensify degradation

Evidence from the preceding chapters points to reinforcing feedback loops that lock coastal systems into a downward trajectory. A typical negative cycle can be summarized, as shown in **Error! Reference source not found.** below:

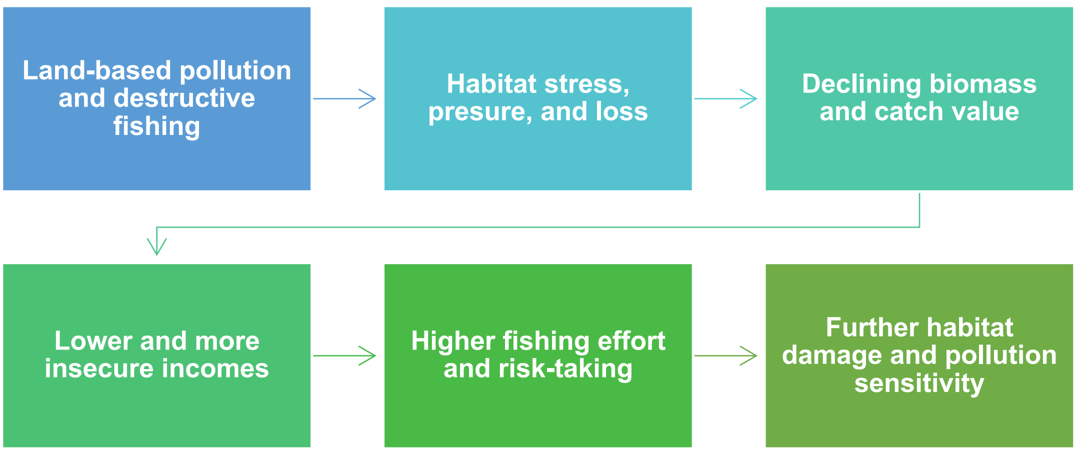


Figure 7-1 Cross-sectoral feedback loops intensify degradation

Because poor households are most dependent on open-access resources and least able to relocate or invest in adaptation, these feedbacks translate into growing social inequity and conflict potential. At the same time, degraded ecosystems reduce the return on public and private investments in tourism, ports and aquaculture, undermining long-term growth prospects. Breaking these cycles requires coordinated action across sectors—wastewater, solid waste, fisheries, protected areas, land-use, and climate policy—rather than isolated project interventions.

7.3 Patterns of Risk Among Spatial Units of Analyses and at Country Scale

The spatial analysis conducted for the TDA shows that coastal–marine risk is highly uneven, concentrating in a limited number of **"hotspot"** zones where intense pressures coincide with high ecological value and vulnerable populations. Five zones stand out as priority areas for management attention and coordinated investment.

1. Koh Kong Complex (Peam Krasop–Koh Kapik–Botum Sakor)

The Koh Kong coastline, including Peam Krasop and Koh Kapik Ramsar sites and the Botum Sakor peninsula, represents Cambodia's single most important cluster of mangroves, peat-rich wetlands and nearshore seagrass (see Chapter 4). These ecosystems underpin coastal protection, blue-carbon storage and small-scale fisheries, while more than 65% of wetland-adjacent households derive the majority of their income from fishing, gleaning and related activities. Risk arises from the interaction of: *(i) land concessions, roads and canalisation that fragment hydrology and increase sediment and nutrient inflows; (ii) peat oxidation and fire risk where mangroves and swamp forests are cleared or drained; (iii) nursery degradation for shrimp, crabs and finfish; (iv) salinity shifts under sea-level rise; and (v) high fishing pressure, including illegal trawl incursions into shallow nursery grounds.* Without improved land-use controls and co-management, this zone could shift from a national resilience asset to a major source of emissions, erosion and livelihood loss.

2. Preah Sihanouk Urban–Industrial Coast

The Sihanoukville–port corridor exhibits the highest concentration of built assets and the strongest land-based pollution signal (see Chapter 3). The zone combines international and domestic ports, SEZs, casinos, dense tourism infrastructure and expanding residential suburbs, but is served by limited and intermittently functioning wastewater systems. Monitoring shows recurrent exceedances of microbial standards (>10^5 CFU/100 mL at several bathing sites), elevated hydrocarbons and heavy metals in port-adjacent waters, and high plastic leakage from poorly managed solid waste. These pressures intersect with high exposure of people and infrastructure to coastal flooding and storm surges, as low-lying reclaimed land and canalized drains rapidly convey polluted runoff to beaches and nearshore reefs. Risk in this zone is therefore driven by the co-location of national-scale assets with weak environmental controls, making Sihanoukville a critical test case for integrated urban, industrial and coastal management.

3. Kampot Bay–Trapeang Ropov Estuary

Kampot Bay and the Trapeang Ropov estuary form a nutrient-rich, mixed-use system where river inflows, bivalve and finfish aquaculture, salt pans and expanding peri-urban development interact. River-borne sediments and nutrients are amplified by farm effluents and inadequate sanitation, generating high turbidity and elevated TN/TP and BOD levels in the estuary. The resulting risks include eutrophication, episodic low dissolved oxygen events that affect cages and wild stocks, and fragmentation of mangroves and seagrass by ponds, roads and salt fields. Because Kampot also functions as a regional tourism and fisheries hub, degradation in this estuary has direct implications for food security, public health and the province's growth trajectory.

4. Kep–Ha Tien Seagrass and Nearshore Corridor

The Kep–Ha Tien corridor, spanning the Cambodia–Viet Nam border, contains the largest relatively continuous seagrass beds in the coastal zone, interspersed with patch reefs and mudflats. These habitats support transboundary fish and invertebrate populations and provide nursery grounds for at least 13 key commercial species. However, the corridor is highly sensitive to turbidity, sedimentation and bottom trawling. Trawl incursions into shallow areas, increased sediment from shoreline modification and nearshore construction, and nutrient inputs from aquaculture and agriculture raise risks of algal blooms and seagrass die-back. Because Kep's local population is small but heavily dependent on marine resources, even moderate ecological degradation can translate into acute livelihood stress, while the transboundary nature of the corridor calls for coordinated management with Viet Nam.

5. Phnom Penh Confluence–Bassac–Mekong Flow Path

Although far from the coast, the Phnom Penh confluence and downstream Bassac–Mekong channels are the dominant conduit for nutrient, microbial and solid-waste loads entering Cambodia's coastal waters (see Chapter 3). High population density, limited wastewater treatment, and industrial and agricultural discharges in the MTB system generate large pollutant loads that are transported through the delta to the Gulf of Thailand and the Viet Nam coast. This flow path is therefore a critical "upstream risk zone," where interventions in urban sanitation, industrial effluent control and agricultural nutrient management will directly influence coastal water quality and transboundary impacts in the Mekong delta and nearshore fisheries.

6. National-Scale Risk Pattern

Across these zones, a consistent national pattern emerges. Coastal–marine risk peaks where:

1. **High population density and economic assets** (urban centres, ports, SEZs, tourism hubs) overlap with
2. **Weak or absent wastewater and solid-waste treatment**, leading to high microbial, nutrient and plastic loads;
3. **High fishing pressure and limited livelihood diversification** drive overexploitation and destructive practices;
4. **Sensitive ecosystems**—mangroves, seagrass meadows, coral reefs and peat wetlands—are already fragmented or degraded; and
5. **High exposure to storms, floods, coastal erosion and salinity intrusion** coincides with low adaptive capacity.

This risk constellation is most pronounced in **Preah Sihanouk**, **Kampot Bay–Trapeang Ropov** and the **Koh Kong complex**, where intense development and ecosystem value are tightly interwoven. **Kep–Ha Tien** stands out as a zone of high ecological sensitivity and transboundary importance despite its small population, while the **Phnom Penh–Bassac–Mekong corridor** illustrates how inland development trajectories shape coastal and regional marine risks.

These patterns confirm that effective responses must operate at multiple spatial scales: strengthening upstream pollution control in the MTB basin; targeting coastal hotspots with integrated urban, industrial and ecosystem management; and safeguarding remaining high-value habitats such as Koh Kong's mangroves and the Kep–Ha Tien seagrass corridor through co-management and regional cooperation.

7.4 Target Audience

The TDA is intended as a shared evidence base for a wide community of decision-makers and stakeholders who influence Cambodia's coastal and marine futures. It provides both a diagnostic of current conditions and a platform for dialogue on priorities, trade-offs and investment options. Key user groups include:

1. National Decision-Makers

National decision-makers, including NCSD, NCCMD, MAFF/FiA, MoE, MPWT, MLMUPC, MoT, and other line ministries—can use the TDA to guide national policy reforms and the roll-out of MSP and ICZM, support NDC implementation, and integrate coastal and marine priorities into wider climate, land-use, and blue-economy strategies. The report also provides an evidence base to inform national budgeting, public investment programming, and regulatory updates such as EIA requirements, effluent standards, protected-area instruments, and fisheries management measures.

2. Sub-National Authorities

Sub-national authorities, including provincial governors, PCCMDs, and district and commune administrations in coastal provinces and across the Mekong–Tonle Sap–Bassac basin, can apply the TDA to strengthen provincial spatial planning, coastal zoning, and investment screening for ports, tourism, aquaculture, and infrastructure. The findings also support more coordinated enforcement of environmental regulations and joint actions across districts—for example, aligned patrol operations, targeted pollution control, and participatory mechanisms that engage local communities in planning and compliance..

3. Sectoral Agencies & Technical Departments

Sectoral agencies and technical departments, such as fisheries research centres, port and maritime authorities, water and sanitation utilities, and technical departments responsible for tourism, environment, and planning—can translate TDA indicators into operational standards, monitoring protocols, and compliance programmes for fisheries, water quality, dredging, shipping, solid waste, and tourism operations. The TDA also helps prioritize critical data gaps, strengthen environmental information systems, and design targeted interventions such as wastewater upgrades, trawl-control actions, and habitat restoration in the highest-risk zones..

4. Development Partners & Regional Institutions

Development partners and regional institutions, including PEMSEA, COBSEA, ASEAN bodies, and major bilateral and multilateral partners (ADB, FAO, UNDP, World Bank, and others), can use the TDA as a common reference to align country strategies, shape GEF and green-climate pipelines, and coordinate programmatic support for ICZM, MSP, wastewater investments, biodiversity protection, and fisheries reforms. The report also strengthens the basis for regional action on marine litter, oil-spill preparedness, fisheries management, and climate resilience across the Gulf of Thailand and the wider South China Sea..

5. Academic & Research Institutions

Academic and research institutions, including universities, national research centres, observatories, and mapping initiatives—can build on the TDA's datasets, maps, and indicator framework to improve long-term monitoring, ecosystem and hydrodynamic modelling, socioeconomic analysis, and scenario development. The TDA also supports co-designed research with government and communities to fill priority knowledge gaps such as blue-carbon stocks, trophic dynamics, and pollution pathways..

6. CFis/CPAs, Civil Society & Community Networks

Community Fisheries (CFis), CPAs, civil society, and community networks can use the evidence to advocate for stronger safeguards, equitable benefit-sharing, and recognition of community rights. The TDA also provides practical grounding to strengthen co-management arrangements, community patrols, ecosystem restoration initiatives, and locally led blue-economy innovations such as low-impact tourism and improved practices in aquaculture..

7. Private Sector

Private-sector actors—including port and shipping companies, SEZs, industrial facilities, aquaculture operators, real-estate developers, tourism enterprises, and financial institutions—can draw on the TDA to assess environmental and climate risks, strengthen ESG and corporate sustainability strategies, and identify priority investments in pollution reduction, resource efficiency, and habitat conservation. The report also helps inform green and blue finance products, public–private partnerships, and voluntary commitments that support the forthcoming SAP and associated coastal investment programme.

By serving these diverse audiences, the TDA aims to function not only as a technical report but as a living reference that underpins the development, implementation and periodic revision of Cambodia's National Strategic Action Programme for coastal and marine management.

7.5 Future Indicator-Based Environmental Assessments

The TDA provides an initial, integrated set of biophysical and socioeconomic indicators that can be used to track change in Cambodia's coastal and marine systems. To transform this one-off assessment into a living monitoring framework that supports adaptive management, several follow-up actions are recommended. If implemented, these actions would transform the TDA from a one-time diagnostic into the foundation of an ongoing, indicator-based environmental assessment system that supports evidence-driven governance of Cambodia's coastal and marine resources.

1. Institutionalize a national coastal–marine indicator framework

A concise set of core indicators should be formally adopted and updated under NCSD and the future NCCMD marine mandate, drawing directly from the TDA. This would include water-quality parameters (BOD, COD, TSS, TN/TP, microbial counts), land-cover metrics (mangroves, seagrass, reefs, built-up area), fisheries indicators (CPUE, catch composition, exploitation rates, Mean Trophic Index), human-pressure indices (e.g., Human Footprint, port and vessel density), and socioeconomic metrics (HDI, poverty rates, livelihood dependence, and ICZM implementation scores) These indicators should be embedded in national reporting processes—such as State of the Environment reports, NDC and SDG tracking, and marine spatial planning (MSP) reviews—so that coastal performance is routinely measured alongside economic and social targets.

2. Expand spatial and temporal monitoring coverage

Current monitoring remains fragmented and uneven across provinces and ecosystems, requiring a progressive expansion plan to achieve representative coverage. Priority measures include deploying continuous or high-frequency water-quality sensors in key estuaries and port areas (such as Sihanoukville, Kampot Bay, and Koh Kong mangrove channels);

conducting annual or biennial mapping of mangroves, seagrass, and coral reefs using remote sensing and field validation to support loss/gain tracking and blue-carbon accounting; maintaining regular CPUE, effort, and trophic-level monitoring through FiA and partners harmonized with regional fisheries systems; and requiring real-time or near–real-time pollution reporting from ports, SEZs, municipal wastewater plants, and major industrial facilities, linked to compliance dashboards for regulators..

3. Move toward full Marine Spatial Planning (MSP)

The TDA's risk maps and hotspot analyses can serve as the analytical backbone for MSP. Indicator trends—such as CPUE decline, eutrophication hotspots, and shoreline erosion—should be systematically overlaid with existing and proposed uses including ports, aquaculture zones, tourism developments, shipping lanes, and conservation areas. This integration can help define no-go or high-precaution zones for new infrastructure, set and periodically revise coastal setback rules and erosion buffers, determine trawl-exclusion areas and gear restrictions aligned with habitat sensitivity, and prioritize critical habitats and blue-carbon areas for strict protection and restoration under MFMAs, MPAs, and community-managed areas..

4. Integrate climate-risk indicators

Future assessments should explicitly link environmental status with climate hazards and adaptive capacity. In addition to conventional water-quality and habitat parameters, monitoring should include salinity-intrusion length and frequency in key rivers and irrigation canals; shoreline-change and erosion-rate indicators; storm-surge and flood exposure for people and critical infrastructure; SST anomalies and coral-bleaching alerts; and drought–flood cycle indices relevant to the Mekong–Tonle Sap–Bassac system. Tracking these indicators will support climate-smart ICZM, prioritisation of nature-based solutions, and integration of coastal risk into disaster management and land-use planning.

5. Develop a shared regional indicator platform

Cambodia's coastal systems are tightly connected to the Gulf of Thailand and the wider South China Sea, so indicator frameworks should be interoperable with neighboring countries and regional bodies. Priority areas for harmonization with Viet Nam and Thailand include nutrient and sediment loads from shared basins, marine-litter and plastic-leakage indicators including riverine inputs, IUU fishing indicators (vessel activity, infractions, sanctions), habitat connectivity metrics for mangroves, seagrass, and reefs, and oceanographic parameters (currents, temperature, salinity) relevant to pollution dispersion and larval transport. A shared platform—potentially under PEMSEA, COBSEA or ASEAN mechanisms—would enable joint assessments, early-warning systems and coordinated responses to transboundary risks.

6. Establish a national data-sharing and transparency mechanism

To maximize the policy value of indicators and strengthen public accountability, Cambodia should move toward open, interoperable coastal–marine information systems. Key steps include establishing a national coastal and marine data portal where MoE, FiA/MAFF, MPWT and port authorities, water utilities, and other agencies upload validated datasets in common formats; standardizing metadata, quality-control procedures, and data-sharing agreements to enable cross-sector integration; providing user-friendly visualizations such as maps, dashboards, and trend graphs for planners, communities, researchers, and private investors; and embedding feedback loops so monitoring results trigger management actions—for example, compliance inspections when thresholds are exceeded, or adaptive zoning updates when environmental conditions deteriorate.

7.6. Overall Conclusion

Cambodia's coastal and marine systems remain ecologically rich and economically important, yet they are now subject to rapid, cumulative and increasingly interconnected pressures. The TDA demonstrates that land-based pollution, habitat degradation, overfishing and climate change no longer operate as separate problems; they interact in ways that accelerate decline and concentrate risks in a limited number of hotspots. Where weak wastewater treatment, destructive fishing, fragile ecosystems and high exposure to floods and salinity intrusion coincide, the system is already close to a tipping point toward chronic degradation.

At the same time, the analysis highlights substantial assets and opportunities. Cambodia still retains extensive mangrove, seagrass and wetland complexes with high blue-carbon value and nursery functions; a vibrant small-scale fisheries sector that can recover under improved management; and growing national commitments to climate action, ICZM and MSP. Investments in wastewater and solid-waste management, fisheries reform, habitat restoration and nature-based coastal protection can therefore deliver multiple dividends—reducing pollution, rebuilding stocks, protecting communities and securing carbon and biodiversity benefits.

The TDA also underscores that governance is the decisive factor that will determine future trajectories. Emerging institutions such as NCCMD, the expansion of MFMAs and MPAs, updated environmental and climate policies, and stronger participation of communities and civil society provide a platform for more integrated, equitable and climate-responsive management. However, this potential will only be realized if indicator-based monitoring, enforcement, spatial planning and financing are scaled up and better coordinated across ministries, provinces and development partners.

Overall, the chapter confirms that Cambodia is now positioned to move from *diagnosis* (TDA) to *action* through a National Strategic Action Programme (SAP) that is spatially explicit, evidence-driven and aligned with national development and climate goals. The risk maps, indicators and priority hotspots identified here offer a clear basis for sequencing interventions, targeting finance and tracking results over time. If these insights are translated into coherent policies, investments and co-management arrangements, Cambodia can shift from a path of incremental degradation toward one of resilient, inclusive, and sustainable use of its coastal and marine resources.

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