Guidelines for MPA Biodiversity Conservation and Sustainable Community Development in APEC Economies

APEC Ocean and Fisheries Working Group

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Asia-Pacific
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Major Abbreviations and Acronyms

APEC	Asia-Pacific Economic Cooperation
CBD	(International) Convention on Biological Diversity
EU	European Union
EBM	Ecosystem Based Management
GEF	Global Environmental Facility
IUCN	International Union for Conservation of Nature
LiDAR	Light Detection and Ranging- A Mapping Technology
MPA	Marine Protected Area
MSP	Marine Spatial Planning
OECM	Other Effective Area-Based Measures
OFWG	Ocean Fishery Working Group, APEC Secretariat
PA	Protected Area
PRA	Participatory Rural Appraisal
SDG	Sustainable Development Goal, UN
UNEP	United Nations Environmental Program
UNESCO	United Nations Education, Science and Culture Organization
WBM	Wetland Banking Mechanism

Major terminologies and glossaries

Marine Protected Area (MPA)

A clearly defined geographical space, recognized, dedicated and managed through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values (IUCN).

Any defined area within or adjacent to the marine environment, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by legislation or other effective means, including custom, with the effect that its marine and/or coastal biodiversity enjoys a higher level of protection than its surroundings (Convention on Biological Diversity-CBD).

Ecosystem-Based Management (EBM)

Ecosystem-based management is an environmental management approach that recognizes the full array of interactions within an ecosystem, including humans, rather than considering single issues, species, or ecosystem service in isolation (Christensen, Norman L.; Bartuska, Ann M.; Brown, James H, et al, 1996).

EBM approach can be applied to studies in the terrestrial and aquatic environments with challenges being attributed to both.

EBM approach is often used in planning the MPA conservation and management program.

Other Effective Area-Based Conservation Measures-OECM

A geographically defined area other than a Protected Area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the in situ conservation of biodiversity, with associated ecosystem functions and services and where applicable, cultural, spiritual, socio–economic, and other locally relevant values (Convention on Biodiversity-CBD).

According to UNEP report, the world total identified ocean area by OECM criteria is 403,639 km^2.

Marine Spatial Planning (MSP)	Marine spatial planning (MSP) is a process that organizes the use of ocean space and manages interactions between human activities (e.g., fisheries, shipping, tourism) and the marine environment. It aims to balance development with environmental protection and promote sustainable use of marine resources. China, EU and UNESCO have developed MSP framework and directive for conducting MSP.
Participatory Rural Appraisal (PRA)	Participatory Rural Appraisal (PRA) utilizes various visual, oral, and mapping tools, such as social maps, transect walks, resource maps, problem trees, and ranking exercises, to enable communities to analyze their own situations, identify needs, and plan development initiatives. PRA is broadly applied by development professionals and workers to facilitate the community stakeholders and project target groups to participate in designing, implementing and monitoring and evaluating the development projects.

1 Introduction

The Asia-Pacific Economic Cooperation (APEC) region encompasses some of the world's most biologically diverse marine ecosystems that support the livelihoods, food security, and cultural heritage of millions of people. These marine environments face unprecedented threats from climate change, overfishing, pollution, and habitat destruction, necessitating urgent collaborative action across economies. The interconnected nature of marine ecosystems means that conservation efforts require transnational cooperation and shared strategies that balance ecological protection with sustainable human development.

As an important output of the APEC-supported Workshop on Marine Biodiversity Conservation and Sustainable Community Development (Project No. OFWG_104_2024A), the following guidelines provide a comprehensive framework for APEC economies to advance marine biodiversity conservation and to promote sustainable community development. The guidelines are developed based on findings of field surveys and case studies in selected China's marine protected areas (MPAs) in Shenzhen City, Zhuhai City of Guangdong Province and Yantai City of Shandong Province. Procedures and steps for MPA conservation and Sustainable Community Development are also drawn upon existing MPA conservation and management practices and experiences in other APEC economies and APEC relevant initiatives and commitments on MPA biodiversity conservation. The recommendations are designed to be adaptable to different local contexts while maintaining a consistent regional approach to addressing the interconnected challenges of marine ecosystem degradation. and community livelihood vulnerability and procedures to encourage community participation in MPA conservation.

The draft guidelines are developed by the research team consisting Chinese experts and reviewed and commented by participants from APEC economies who attended the Shenzhen Workshop from 28 to 30 October 2025. Successful cases and practical models presented in this guidelines are produced on the basis of field surveys in China and on-line questionnaire survey, literature review and direct contributions of Workshop participants from relevant APEC member countries.

The targeted users of the guidelines are governmental policy makers, local governmental officials for marine and fishery resource management, MPA management and technical staff and community development workers, MPA management related researchers and professionals, as well as the MPA conservation related NGO staff and volunteers.

2 Guiding Principles for MPA Conservation and Sustainable Community Development

Effective marine biodiversity conservation and community development actions in APEC economies should be guided by several fundamental principles that ensure comprehensive and equitable outcomes while implementing the recommended policies and actions.

2.1 Ecosystem-Based Management

The ecosystem-based management (EBM) approach represents a paradigm shift in marine conservation, moving beyond single-species protection to address challenges and threats to entire ecological systems and their interconnected processes. The ecosystem-based management (EBM) is a management concept in which many influencing factors are comprehensively considered, such as ocean currency, climate conditions and climate change, social and economic features of the marine resource users. Within the Asia-Pacific Economic Cooperation (APEC) forum, which comprises 21 member economies bordering the Pacific Ocean, this approach has gained significant traction as a framework for balancing ecological integrity with socio-economic needs.

The Asia-Pacific Economic Cooperation (APEC) region encompasses a vast and geographically diverse areas, stretching from the tropics to the polar regions. This results in incredible and very diversified marine and coastal ecosystems, each type of the ecosystem has immense ecological and economic values.

Table 1. Typical Marine Ecosystems existing in APEC Region

Ecosystem	Key Characteristics	Prominent APEC Examples
Coral Reefs	High biodiversity, coastal protection, tourism	Great Barrier Reef (Australia); Guangdong, Guangxi and Hainan, People's Republic of China; Coral Triangle (Indonesia; Papua New Guinea; The Republic of the Philippines)
Mangrove Forests in the coastal and estuarine regions	Coastal nurseries, storm protection, carbon sinks	Indonesia (world's largest), Southern China Coastal Region; Malaysia; Mexico; Thailand;
Seagrass Meadows	Sediment stabilization, feeding grounds for megafauna	Australia (Shark Bay); Southern China; Southeast Asia; USA (Florida)
Kelp Forests	Cold-water forests, high productivity	Canada (BC); Chile; Russia (Kamchatka); USA (California)
Estuaries & Intertidal Ecosystem	Highly productive, bird migratory stopovers	Yangtze River, Yellow River, and Pearl River Estuaries in People's Republic of China; Chesapeake Bay in USA
Deep-Sea & Open Ocean	Vast, seamounts, hydrothermal vents, major fisheries	Pacific Ring of Fire vents, pelagic migration corridors
Polar Marine Ecosystem	Cold-adapted species, krill-based food web	Southern and Northern Pacific Ocean (Canada; Chile; Russia; USA, etc.)

These ecosystems are not isolated, they are interconnected. For instance, mangroves and seagrasses can help protect nearby coral reefs by filtering sediment, and many fish species use multiple ecosystems throughout their life cycles. The health and sustainable management of these marine ecosystems are directly linked to the economic prosperity and food security of the entire APEC region.

Following operational principles must be followed in implementing the MPA EBM practices:

(1) **Ecological Connectivity Principle:** EBM are designed to maintain ecological processes that operate across landscapes and seascapes, including sea animal migrations, nutrient cycling, and hydrological flows. This often requires networks of MPAs rather than isolated protected areas (PA), with connectivity considerations informing their size, spacing, and location. An accessible information sharing mechanism and an effective platform shall be considered for construction and operation.

(2) **Multiple Objective Integration:** The EBM explicitly seeks to balance conservation goals with sustainable marine resource use objectives, recognizing that complete protection is neither practical nor desirable in many different socioeconomic contexts. This includes zoning schemes that allocate areas for different uses, from strict protection to sustainable extraction and recreation.

(3) **Precautionary Approach**: Given the incomplete understanding of marine ecosystem dynamics determined by many interlinked factors, EBM employs precautionary measures in the face of impact and result uncertainties, particularly regarding irreversible biodiversity impacts such as species extinctions or ecosystem collapse. In this context, sufficient site pilots and researches for precautionary testing the conservation measures and results are recommended to the governmental MPA management authorities and Marine Nature Reserves.

(4) **Stakeholder Engagement:** Governmental authorities in charge of marine resource management shall recognize that active participation of local communities, indigenous groups, industry representatives, and other stakeholders is central to the EBM process, that MPA conservation outcomes not only rely on the technical and policy interventions, but also depend largely on social acceptance and commitment of the local resource users including stewardship. MPA protection awareness building and enhancement through public education is important for stakeholder's engagement in the whole process of MPA conservation. To ensure the stakeholder's engagement, it is important to carry out a systematic stakeholder analysis before designing the MPA conservation projects.

(5) **Adaptive Governance and Management:** EBM of MPAs require flexible institutions that can respond to changing environmental conditions and emerging knowledge. This includes monitoring programs that track ecological and social outcomes, with responsive management adjustments based on results of performance monitoring. The adaptive governance and management principle shall be also effectively mainstreamed into the process of formulation and implementation of national and local MPA conservation related policies and regulations.

2.2 Intergenerational Equity Principle

Natural resources, biodiversity and ecosystems in MPAs and river estuarine wetlands protected areas, are not the property only for our generation, but also for future generations. This must be recognized and agreed by all stakeholders including the marine and wetland resource users.

Applying intergenerational equity principle in MPAs and river estuary wetlands PA management practice is to ensure that present conservation and development measures and actions do not compromise the ability of future generations to meet their needs and enjoy the benefits of healthy marine ecosystems.

To effectively apply this principle, following approaches need to be conducted:

(1) Conduct systematic ecological assessment and baseline studies through engaging relevant stakeholders, including the community stakeholders and marine resource users.
(2) Set up intergenerational equity goals and objectives and relevant measurable and achievable targets (indicators) during designing and formulating MPA biodiversity conservation projects and sustainable community development projects.
(3) Set up: (i) Conservation of options**:** Protect genetic resources, endangered marine and land territorial species, and ecosystem diversity to ensure future generations have comparable choices for use of these resources; (ii) Conservation of quality**:** Maintain or improve ecosystem health (e.g., water quality, habitat integrity) so that future generations inherit conditions no worse than today; (iii) Conservation of access**:** Ensure equitable access to cultural and natural resources for present and future communities and resource users.
(4) Formulate the MPA sustainable management plans through multi-stakeholder engaged MPA sustainable management planning workshops to ensure their commitments to conserve the marine resources.

2.3 Social Inclusion and Gender Equality

(1) Actively promote the participation of all community members and stakeholders in decision-making processes, with particular attention to ensuring gender equality, engaging indigenous peoples, and including other marginalized social groups whose livelihoods and cultures depend on marine resources. Community participation and stakeholder's consultation in establishing MPAs, conducting PMA management planning, Marine Spatial Planning (MSP), in carrying out zoning and the function area establishment within MPA as well as in identifying the conservation and management strategies and other effective area-based conservation measures (OECM).
(2) The social inclusion and gender equality principles shall be mainstreamed into whole lifecycle of the MPA conservation projects, including assessment of the threats and challenges faced by MPA conservation, in planning the conservation strategies and actions, implementation and monitoring and evaluation processes. It is recommended that the measurable female participation and benefit indicators shall not less than 30%-50%to ensure the social inclusion and gender equality. The indicator of female residents participation and benefit shall be applied for guiding the design of the community development projects and in the project impact monitoring and evaluation (M&E). To ensure the mainstreaming, it is also recommended to prepare social and gender development plan during the project design and incorporate into the project design document, For the MPA Conservation and Community Development Projects implemented in the ethnic minority areas and indigenous communities, a special ethnic and indigenous community development action plan shall also be prepared and implemented.

(3) As a legal precondition of engaging the community resource users and vulnerable social groups, particularly the women, poor people and ethnic and indigenous groups, resource use right and tenure of these social groups must be legally recognized by the governmental laws or acts.
(4) Information disclosure to relevant stakeholders. To ensure the social inclusion and active participation of stakeholders and resource users, it is important to inform them on the threats and challenges of MPA and conservation strategies, objectives, the major actions as well as the alternative livelihoods and sustainable community development plans. Information on MPA conservation and community development initiatives and projects shall be publicized through community public campaign, school education and public media, such as TV, Newspaper, Webpages, etc.

3 Integrated MPA Management Approaches

For effective management of MPAs located in different marine ecosystems in APEC region, and conservation of the MPA biodiversity threatened by climate change and over use of marine resources, there are systematic steps and approaches applied in the management practice. This chapter will present major approaches for MPA management in APEC Region.

3.1 Carry out Threats and Challenge Assessment for MPAs

MPA threat and challenge assessment is the first step and foundation for the identification and the establishment of MPAs and planning the MPA and OECM management plans and strategies. Following procedures are recommended:

Phase I. Assessment Preparation

- Define Assessment Objectives: Clearly state the purpose (e.g., MPA management plan revision, climate resilience planning, ecosystem health report, blue economy impact assessment).
- Establish the Assessment Team: Form a multidisciplinary assessment team with MPA managers, scientists (ecologists, oceanographers, social scientists), economists, local community representatives, indigenous groups (where applicable), industry stakeholders, and relevant government agencies (fisheries, environment, tourism, coast guard, etc.).
- Delineate Assessment Boundaries/Scope
    - Geographic: The MPA itself, its buffer zones, and connected ecological seascapes (e.g., migratory routes, watersheds, adjacent fishing grounds).
    - Temporal: Current status, projected trends (short, medium, long-term).
    - Thematic: Ecological, socio-economic, governance, and climate change dimensions.
- Review Existing Information: Collate and analyze existing data from management plans, scientific studies, state of environment reports, traditional ecological knowledge, compliance records, and socio-economic baselines.
- Prepare a TOR and work plan for the assessment. The work plan should specifically describe the objective, the scope of the assessment, major areas and dimensions of the assessment, methods and tools, major outputs and deliverables, task designations within the team, time schedule for carrying out the assessment, etc.

Phase II: Systematic Identification of Threats and Challenges

- Pre-Categorize Threats & Challenges: Use a structured framework (e.g., IUCN-CMP Unified Classification of Direct Threats, or DPSIR - Drivers, Pressures, State, Impact, Response).
- Conduct Stakeholder Workshops: Hold participatory workshops (in-person/virtual) with identified groups to elicit local and expert knowledge on perceived and actual threats.
- Inventory and identification of threats
  Conduct on-site investigation to identify and assess the existing threats and challenges and degradation status by flexibly use of quantitative and qualitative tools, such as Transect Walk, Threat Mapping, eDNA technologies, drone, etc. the on-site investigation will focus on following aspects:
    - Ecological and biodiversity threats: Overfishing (legal/illegal), destructive fishing practices, coastal habitat loss/degradation (mangroves, corals, seagrass), pollution (land-based runoff, marine debris, chemicals), invasive species, vessel traffic (noise, strikes, anchoring), aquatic animal diseases.
    - Climate Change: Ocean acidification, sea-level rise, increasing sea surface temperatures, altered circulation patterns, increased frequency/intensity of storms.
    - Socio-economic: Unsustainable tourism, coastal development, resource use conflicts (e.g., fishing vs. conservation), lack of alternative livelihoods, displacement of communities.
    - Governance & Institutional: Insufficient funding, weak enforcement/patrolling capacity, unclear tenure/use rights, legal gaps, lack of inter-agency coordination, limited stakeholder engagement mechanisms, political instability, corruption.
    - Knowledge Gaps: Inadequate baseline data, limited monitoring, uncertain cumulative impact models.

Phase III. Analysis and Prioritization of threats and challenges

It is recommended to conduct a threat and challenge assessment workshop by use visualization tools, problem trees, threat ranking, etc. The workshop will be facilitated by a selected person from the assessment team. Major Tasks of the workshop will focus on followings:

- Characterize Threats: For each identified threat, describe:
    - Scope & Scale: Geographic extent and magnitude.
    - Severity: Intensity of damage/impact on key conservation values (species, habitats, ecosystem services).
    - Irreversibility/Permanence: Likelihood of recovery.
    - Frequency/Trend: Is it increasing, stable, or decreasing?
- Root Cause and Systems Analysis:

    - Identify Drivers: For high-priority threats, analyze the underlying drivers (e.g., poverty, market demand, policy failures, population growth).
    - Map Linkages: Understand how threats interact (e.g., climate change exacerbates pollution impacts, weak governance enables overfishing). Create conceptual models of cause-effect chains.
- Assess Vulnerability & Risk: Combine threat characteristics with the exposure and sensitivity of key MPA assets (e.g., coral reefs to warming, communities to fishery declines) to assess risk. Use qualitative (expert judgment matrices) or semi-quantitative methods.
- Prioritize: Rank threats based on risk level and management urgency. Common tools include:
    - Risk Matrices: Plot likelihood vs. consequence.
    - Multi-Criteria Analysis: Score threats against agreed criteria (e.g., ecological impact, social impact, manageability).
    - Participatory Voting: Stakeholders rank threats.

Phase IV: Documentation and Reporting

Prepare Assessment Report: Document the process, findings, and priorities. Include: Executive Summary, Assessment Methodology, Detailed threat inventory and characterization; Prioritization results with justification; Analysis of linked threats and root causes, Recommendations for conservation; annex: Maps and visualizations.

3.2 Carry out Ecosystem-Based Marine Spatial Planning

Marine spatial planning (MSP) is a useful procedural framework and a set of tools applied in Marine Protected Area Management Planning. MSP focuses on the use of ocean space and manages interactions between human activities (e.g., fisheries, shipping, tourism, etc.) and the marine environment. Currently, UNESCO, EU and China have developed MSP frameworks and procedures to guide the planning practices.

Implement comprehensive marine spatial planning (MSP) that allocates space for different uses while ensuring the conservation of critical marine habitats and marine ecosystems. It is recommended that APEC economies will use MSP tools in planning and establishing MPAs and Other Effective Area-based Conservation Measures (OECMs) as core components of these spatial plans. Key MSP procedures include:

(1) Collect and incorporate scientific data on marine and territorial species distributions, habitat sensitivity, oceanographic processes, and climate change projections, socio-economic data on the communities in the surrounding areas of the MPAs;
(2) Identify areas of particular ecological significance that require special protection based on the data analysis and functional zoning;
(3) Designate zones for different sustainable uses, including fishing, tourism, and energy development;
(4) Establish ecological connectivity corridors to ensure genetic exchange between populations and between different MPAs within the marine region;
(5) Include adaptive management provisions to adjust plans based on monitoring data and changing conditions.

Box 1. UNESCO 10 Steps of MSP

Step 1: Establishing Authority and Identifying Needs: This initial phase involves determining the purpose of MSP and establishing appropriate institutional structures with clear mandates and responsibilities for planning and management.

Step 2: Securing Financial Support: Identifying potential funding mechanisms and assessing their feasibility ensures that the planning process has adequate resources throughout its implementation.

Step 3: Pre-Planning Process: This involves assembling an MSP team, developing detailed work plans, defining spatial and temporal boundaries, establishing guiding principles, setting clear objectives, and identifying potential risks with contingency planning.

Step 4: Organizing Stakeholder Participation: Determining who should be involved, when they should participate, and how their engagement will be structured throughout the planning process.

Step 5: Defining and Analyzing Existing Conditions: Collecting and mapping ecological, environmental, oceanographic data and human use information to identify current conflicts and compatibilities among marine activities.

Step 6: Defining and Analyzing Future Conditions: Forecasting trends in human uses of marine space, estimating future spatial and temporal requirements, developing alternative scenarios, and selecting the most appropriate spatial use scenarios.

Step 7: Developing and Approving Spatial Management Plan: Establishing alternative spatial-temporal management measures, developing zoning schemes, evaluating spatial management plans, and obtaining formal approval.

Step 8: Implementing and Enforcing the Plan: Executing the spatial management plan, ensuring compliance, and enforcing regulations.

Step 9: Monitoring and Evaluating Performance: Developing performance monitoring plans, evaluating monitoring data, and reporting on results.

Step 10: Adapting the Planning Process: Reviewing and redesigning MSP based on evaluation findings, identifying research needs, and initiating subsequent planning cycles.

Source: UNESCO, 2009 Marine spatial planning A Step-by-Step Approach toward Ecosystem-based Management.

Box 2. MSP Procedures developed and applied in China

The Chinese MSP procedures consist of three phases and 11 steps:

(1) Preparation Phase

- The preparation phase establishes the **foundational work** necessary for effective planning. This stage involves significant organizational efforts, including establishing a specialized planning compilation team with cross-regional coordination mechanisms.
- Another critical component in this phase is developing a detailed **work plan** that specifies MSP objectives, concrete work content, operational procedures, personnel organization, and financial support.
- The preparation phase also includes preliminary testing and determination of technical routes and methods supported by **information technology**. Geographic information systems (GIS), remote sensing, and big data technologies play crucial roles in data collection, analysis, and visualization throughout China's MSP process.

(2) Planning Formulation Phase

This central phase involves several **key components** that transform preparatory work into concrete planning outcomes:

- **Marine Spatial Status Assessment**: Investigating and evaluating current marine spatial resources and uses according to suitability, scientific, and ecological principles. This assessment establishes the baseline understanding of marine resources and utilization patterns.
- **Supply-Demand Balance Analysis**: Analyzing the balance between marine space supply and demand to forecast future trends and inform spatial allocation decisions.
- **Marine Spatial Utilization Objectives**: Developing constraining and anticipatory indicators based on current conditions and problems, guided by overarching goals.
- **Plan Development and Optimization**: Selecting specific planning projects, conducting in-depth research, preparing alternative schemes, and choosing optimal solutions through comparative evaluation.
- **Stakeholder Consultation**: Organizing meetings to gather feedback from interested parties, reconcile multiple interests, and resolve conflicts. China specifically mentions methods such as media information releases, social questionnaires, hearings, expert seminars, and field investigations.

(3) Approval and Implementation Phase

The final phase involves **formal approval** and practical application of the developed plan:

- **Examination and Approval Process**: Completed plans undergo technical appraisal and revision by leading groups and relevant government

departments before submission to higher authorities for review and record-filing. For areas involving international boundaries, China emphasizes the need for **multilateral negotiations** at the national level with relevant countries.

- **Implementation**: Various social actors including government, individuals, for-profit organizations, and non-profit organizations are expected to consciously follow the MSP and engage in marine protection and scientifically sound utilization practices.
- **Monitoring and Evaluation**: China emphasizes establishing effective **supervision and feedback mechanisms** to gather opinions and suggestions from practical implementation, with regular revisions to the marine spatial plan based on this feedback.

Source: http://www.360doc.com/content/20/0414/06/33506793_905806990.shtml

3.3 Implement Climate-Resilient Conservation Strategies

The **Asia-Pacific Region** encompasses some of the world's most diverse and ecologically significant marine ecosystems. MPAs within APEC economies serve as crucial conservation tools designed to protect marine biodiversity, sustain fisheries, and safeguard ecosystem services. However, these protected areas face unprecedented challenges from climate change, which threatens to undermine their conservation objectives.

Major threats caused by the climate change on MPAs in APEC economies are summarized in following table.

Table 2. Major climate-related threats and impacts on marine ecosystems in APEC economies

Threats caused by Climate Change	Impacts on MPA biodiversity
Ocean warming and thermal threat	● Rising sea surface temperature; ● coral bleaching events, metabolic changes in marine organisms; ● Shifts in species distribution patterns that fundamentally alter ecosystem structure and functions; ● Melting polar ice changes the habitats ecosystem and threatens the polar animals and sea animals in north and south polar regions of Pacific Ocean.
Ocean Acidification	● Sea water acidification causes the chemical changes, which poses particular threats to calcifying organisms such as corals, mollusks, and certain plankton species that struggle to build and maintain their calcium carbonate

	structures in more acidic waters. ● Shellfish populations may decline, affecting food webs and commercial fisheries.
Sea level rise and coastal modification	● Impacts on critical habitats such as mangroves, salt marshes, coral reefs, and seagrass beds that provide essential ecosystem services and serve as important marine habitats for sea animals and for carbon sinks. ● **Altered Hydrological Patterns**: The inundation patterns in coastal MPAs are being transformed by sea level rise, changing salinity gradients, sediment deposition, and nutrient cycling processes. These changes can alter the composition of ecological communities and reduce the effectiveness of MPAs designed to protect specific coastal habitats (ADB Report, 2017).
Increased frequency and intensity of climate disasters	● Increased hazards and extreme weather events, damaging the infrastructures of MPAs; ● Destruction of habitat ecosystem for migrant birds and fishes and sea animals listed by IUCN; ● Economic losses in fishery sector, affecting on the livelihoods of communities located in the small islands and coastal regions.
Biodiversity losses	● Mangrove vegetation changes and seagrass bed losses; ● Reduced marine and territorial MPA carbon sequestration capacity; ● Endanger vulnerable sea animal species.

Table 3: Climate Change Impacts on Major Marine Ecosystems in APEC Economies

Ecosystem Type	Primary Climate Threats	Key Impacts	Implications for MPA Objectives
Coral Reefs	Warming, acidification, storms	Bleaching, reduced calcification, structural damage	Biodiversity loss, reduced fisheries productivity, diminished tourism value
Mangrove Forests	Sea level rise, warming, changed hydrology	Coastal squeeze, reduced regeneration, mortality	Reduced coastal protection, carbon release, nursery habitat loss

Seagrass Beds	Warming, reduced light, storms	Reduced productivity, meadow fragmentation	Carbon sequestration decline, habitat loss for associated species
Kelp Forests	Warming, extreme heat events	Range contractions, reduced canopy cover	Biodiversity loss, reduced primary production
Open Ocean/Pelagic	Warming, acidification, O_2 depletion	Species Community reorganization, direct pollutions on the sea life species and coral reefs	Biodiversity loss Degradation of corals
Polar ocean ecosystem	Warming water, ice melting, etc.	Threat to polar animals, Structure Changes of migratory sea animals	Change of biodiversity in polar ocean, but threat to small islands in APEC region

Develop climate smart marine conservation strategies that explicitly address climate change impacts on local marine ecosystems and coastal communities. Major recommended adaptation actions include:

(1) Conduct climate vulnerability assessment for identifying and protecting climate refugia – areas that are less vulnerable to climate change and can serve as natural reservoirs of biodiversity and species which are most vulnerable and to be protected and conserved; see table 3 below.
(2) Develop and implement Climate Smart MPA Conservation Strategies for guiding the conservation actions (see table 4, the major components of MPA Conservation Strategy).
(3) Incorporate the climate resilient countermeasures into MPA Management Plan as important component.
(4) Conduct climate-resilient habitat restoration activities at the MPA level (see the components illustrated in table 6).
(5) Formulate and implement local policy by multi-stakeholder consultation to reduce non-climate stressors such as pollution and habitat destruction to enhance ecosystem resilience.
(6) Implementing adaptive management frameworks that allow for flexible responses to changing conditions through MPA ecosystem monitoring by use of AI technologies.
(7) Developing community adaptation plans that address how changes in marine resources will affect livelihoods and food security.
(8) Developing and implementing impact monitoring and evaluation plan with specific indicators to measure the ecological impacts, social and economic impacts of various interventions.

Table 4: Key Components of Climate Vulnerability Assessment for Marine Ecosystems

Assessment Component	Key Elements/and Indicators	Methodological Approaches
Exposure Evaluation	Rate of temperature change, acidification levels, frequency of marine heatwaves	Climate projection models, historical data analysis, remote sensing
Sensitivity Analysis	Species thermal tolerances, habitat specificity, reproductive vulnerability	Laboratory experiments, field observations, trait-based assessment
Adaptive Capacity Assessment	Genetic diversity, phenotypic plasticity, dispersal capability	Population genetics, larval dispersal models, ecological monitoring
Refugia Identification	Thermal buffering, structural complexity, historical stability	Remote sensing, biophysical modeling, comparative analysis

Table 5: Climate Adaptation Strategies for MPAs in APEC Economies

Strategy Type	Specific Approaches	Expected Benefits	Implementation Examples
Ecological	Protection of climate refugia, habitat restoration, assisted migration	Enhanced biodiversity, maintained ecosystem function, carbon sequestration	Coral reef restoration, mangrove protection, seagrass rehabilitation
Socioeconomic	Livelihood diversification, ecotourism development, sustainable aquaculture	Reduced resource pressure, enhanced community resilience, alternative income sources	The Philippines' community-based tourism, integrated multi-trophic aquaculture
Technological	Advanced monitoring systems, AI-based forecasting, coral bleaching prediction	Early warning, rapid response, improved decision-making	Satellite monitoring, ocean drones, automated alert systems
Governance	MPA networks, transboundary management,	Coordinated action, conflict reduction, equitable	Regional coral reef partnerships, community

	community co-management	distribution of benefits	conservation agreements
Financial	Blue carbon credits, climate resilience funds, payment for ecosystem services	Sustainable financing, economic incentives for conservation	Mikoko Pamoja carbon project, Green Climate Fund applications

Table 6: Climate-Resilient Habitat Restoration Approaches for Marine Ecosystems

Restoration Approach	Key Technologies	Climate Resilience Benefits
Blue Carbon Ecosystem Restoration	LiDAR (Light Detection and Ranging) Mapping Technologies, carbon baseline assessment, satellite monitoring	Carbon sequestration, coastal protection, biodiversity enhancement
Coral Larval Capture	Larval settlement devices, laboratory rearing techniques	Genetic diversity maintenance, increased adaptive capacity
Sea carbon sequestration and low emission Agriculture	Sargassum-based compost production, soil carbon enhancement for reducing the non-point source pollution caused by high input agriculture in the estuarine region.	Reduced coastal pollution, improved food security, carbon cycling
Seascape Connectivity Restoration	GIS-based planning, hydrodynamic modeling, habitat corridor design	Facilitated species movement, meta-population resilience

4 Community Engagement and Participation

4.1 Importance of community participation in MPA Biodiversity Conservation

In the traditional coastal and river estuarine marine communities, local residents mainly depend on the marine or wetland resources to sustain their traditional and indigenous livelihoods, such as fishing, aquaculture, farming, etc. Community participation is a crucial aspect of marine biodiversity conservation in APEC economies, as local communities often depend on marine resources and play a key role in sustainable management.

4.2 Establish Inclusive Governance Structures

Establish participatory governance mechanisms that ensure meaningful involvement of local communities, indigenous peoples, and other marine resource use related

stakeholders in marine conservation and management decisions. As highlighted in the APEC roundtable meetings, respecting local and indigenous traditional wisdom and ensuring public-private cooperation are essential for successful marine conservation. Effective governance structures should:

(1) Create multi-stakeholder participatory consultation platforms/mechanism for dialogue and decision-making that include government agencies (e.g. Natural Resource Bureaus, Urban Development Planning Bureau, Marine and Estuarine Wetland Natural Reserves, etc.), local community leaders (Councilors), ethnic and indigenous groups, women's organizations, scientific experts, marine environmental protection volunteers and private sector representatives.
(2) Recognize and integrate traditional ecological knowledge alongside scientific knowledge in management decisions.
(3) Ensure equitable representation of all community segments, including women, youth, and marginalized social groups, social groups as marine resource users who will be potentially most affected by the MPA conservation activities.
(4) Provide capacity building support to enable effective participation of community representatives in technical discussions.

Box 3. Key factors for the success of the community participation in MPA biodiversity conservation

- Traditional Knowledge Integration–Combining indigenous practices with modern science and technologies for MPA conservations.
- Economic Incentives – Concern the community livelihoods while planning the MPA biodiversity conservation. Planned biodiversity conservation actions and programs must be systematically linked with sustainable community development activities, such as ecotourism or sustainable fisheries, etc.
- Legal Recognition – legally recognize the formal rights for communities to manage the marine and estuarine wetland resources as precondition to engage the community stakeholders.
- Partnerships– NGOs, governments, and academia jointly supporting the local efforts and actions in MPA conservation and community alternative livelihood activities and projects.

4.3 Pilot Community-led MPA Management Models

The community-led MPA management models are mainly piloted and applied in managing the OECM areas where formal MPAs not yet established and enclosed, and community economic activities are still allowed under the balance with the MPA conservation strategies.

Support community-led marine management initiatives that empower local communities to manage their marine resources, to build their ownership on conserving and restoring the marine resources and protecting the marine species and migratory birds in Mangrove and Salt marshes.

Major steps of preparing and implementing the Community-Led MPA Management

Projects include:

(1) **Participatory Community Assessment:** by use of Participatory Rural Appraisal (PRA see box 6) Tools, the planning team and facilitator will conduct participatory community assessment with focus on factors threatening the MPA, marine habitats and biodiversity, stakeholders related to the marine and wetland resource use, fishermen, farmers, etc. and assess the livelihood restrictions caused by the MPA conservation; the planning team shall conduct focus group interview and community transect walk, for identifying the threats and needs on community development; for assessing the impacts of MPA conservation on the community livelihood, the tool of Sustainable Livelihood Assessment Framework can be applied.

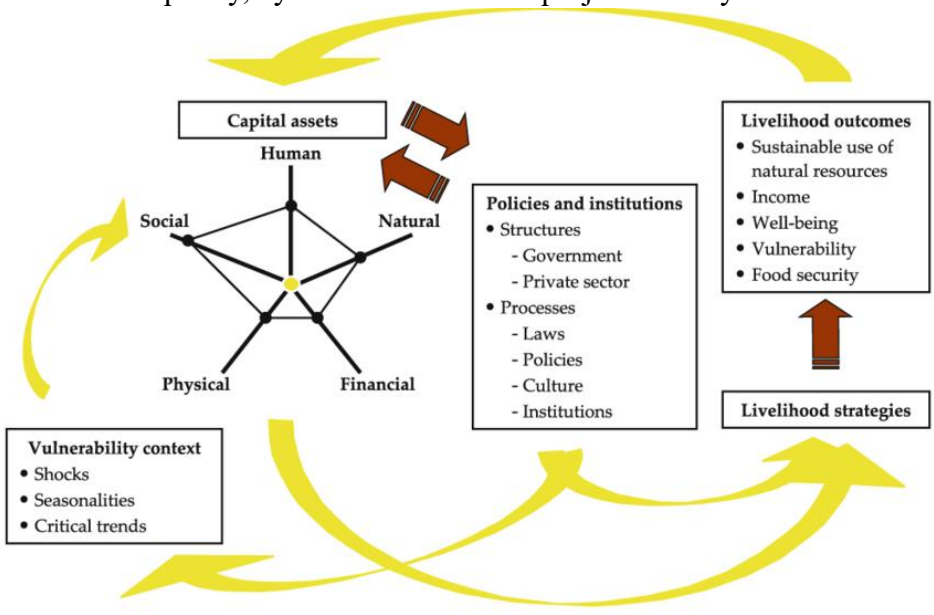
Box 4. Sustainable Livelihood Assessment Framework

The Sustainable Livelihood Assessment Framework (SLAF) is a holistic, people-centered analytical approach to understanding how individuals, households, and communities build, maintain, or lose their means of living in different contexts. It can be also applied in assessing the negative and positive livelihood impacts caused by the natural resource and ecosystem conservation and by climate change and shock of natural disasters. It can also be used for identifying alternative livelihood projects.

The analysis framework consists of five livelihood assets which interrelated and builds an livelihood pentagon. The five livelihood assets include:

(1) Natural Asset: land, water, marine, production relied ecosystem,etc.;
(2) Physical Asset: farming and fishing tools, facilities, equipment, infrastructures, etc.;
(3) Financial Asset: income sources, investment funds, etc.;
(4) Social Asset: social and institutional network within and outside of the community, social capitals and social trust, etc.;
(5) Human Asset: labors, skills, etc.

These assets for a family can be positively or negatively changed and affected by resource use policy, by MPA conservation projects and by shock of natural disasters.



Source: Department for International Development, UK

For MPAs & Coastal Communities:
(1) Natural Capital Focus: Fisheries health, mangrove/wetland services, coral reef benefits;
(2) Key Livelihood Strategies: Fishing, tourism, aquaculture, gleaning;
(3) Critical Vulnerabilities: Resource access restrictions, climate impacts, market fluctuations;
(4) Institutional Analysis: Co-management arrangements, customary marine tenure, fishing rights.

(2) **Design and Planning the Community-led Marine Management Projects.** Participatory Project Design and Planning Workshop will be organized, relevant community stakeholders, community leaders (community council members), women, fisherman association, etc., will be participating in the whole process, to set up MPA management objective, major management components, major changes of resource use patterns to conserve the MPA biodiversity, major actions to conserve the MPA biodiversity in different conserved zones (No-Take Area), the major alternative livelihood activities after changing the resource use patterns. PRA tools will be selectively used to facilitate the participation of the stakeholders. Planning workshop will be facilitated by the consultant team, the outputs of the workshop will be documented and used for formulating the Community Led MPA management projects.
(3) **Implementation and Monitoring:** The formulated management strategy and conversation actions and livelihood activities should be publicized within the community. The consultant team and community leaders will jointly prepare project proposal with budgets and apply funding from the local or central governments, from NGOs or through social donations. Assist the local community to set up implementation coordination group to implement planned conservation and management activities and livelihood development activities (See 4.4). The effectiveness and impacts of the planned activities will be monitored through participation of the community stakeholders.
(4) **Impact Evaluation:** Conduct participatory impact evaluation by involving community stakeholders, women, fishermen, etc. Evaluation exercise will focus on: (i) ecological impacts on recovery of marine and territorial species, migrant birds and marine and territorial animals, etc. (ii) socio-economic impacts, such as household income, social well- being, ecological awareness enhancement, etc.
Source: https://lmmanetwork.org/wp-content/uploads/2021/08/Govan-et-al-2008-LMMA-CBAM-Guide.pdf

Box 5. Participatory MPA Management Case in Peru

1. Case Summary

The local fishermen of Marcona (Ica, Peru), who benefit from the marine resources of San Fernando Cove (Ensenada de San Fernando), were engaged in participatory processes to create and categorize a National Reserve. The fishermen are active partners in current management through the Management Committee of the National Reserve of San Fernando.

2. Key Actions and Solutions:

(1) Conduct dialogue between fishermen groups and MPA officials

Local participation, dialogue and scientific data have to be considered to decide the future management scheme of the protected area. Agreements should be recorded, consistency of the different actors' positions documented. A General Assembly open to the public generates a sense of openness and disseminates general information. Management committee Interested local stakeholders are invited, members are registered and a council with a president are elected by the General Assembly.

(2) Establish MPA Management Committee

The management committee becomes a space for dialogue, facilitates support to the protected area management authority. Hence, decisions are based on formal processes and communication between the government authorities and locals is fluid.

(3) Ensure the legal resource use rights

Legal resource rights were assigned to local management groups to carry out sustainable use activities if the groups commit to providing support in surveillance and enforcement. If allocated rights to use a specific resource, the locals can be a vital ally.

3. The Impacts

Traditional fishery rights are respected to avoid the tragedy of the commons. When the Reserved Zone of San Fernando was created, exploitation of marine macroalgae increased. In the process of classifying the Reserved Zone as a National Reserve, local fishermen generated revenue from resource collection. This led to assignment of resource use rights, ensured that fishermen contribute to control and surveillance. Co-management helped slow migration from the highland in search of economic benefits from macroalgae use. The creation of a Management Committee, bringing together different associations of fishermen and stakeholders, allows for different perspectives in management dialogues and reduces conflicts. This creates a formal communication channel regarding the MPA and helps with zoning permitted and not permitted uses in the MPA.

Source: IUCN, 2018 Publication, Solutions in Focus: Community Led Success in Marine Conservation

Box 6. Case of Community Led MPA Management in Indonesia

1. Case Summary

The Bird's Head Seascape (BHS) addresses habitat destruction from overfishing and resource exploitation in West Papua, Indonesia, through a large-scale ecologically-connected and community-driven Marine Protected Area (MPA) network to preserve biodiversity and regenerate local fisheries. Ultimately, the goal is for local Papuan communities to have enhanced food security, livelihoods, cultural heritage and rights.

2. Key Actions and Solutions

(1) Ecosystem-based management science program

The interdisciplinary program generated information that guided the development of the strategy. Understanding the community dynamics and gaining information on

areas where protection reduces existing community conflicts is incredibly helpful.

(2) Social and political support and partnership
A coalition of partners across the seascape was created engaging coastal communities through communication and education strategies. Community conservation officers for each village were trained and equipped with environmental training.

(3) Development of ecologically connected co-managed MPA network
A management system empowering local communities to lead the planning, management and program implementation of the BHS MPA network is developing. Conservation process can be used as a means to strengthen the rights and culture of local communities.

(4) Adequate capacity and co-management institutions
A comprehensive MPA Management Capacity Building Program was designed to turn local village leaders, MPA practitioners and government officials into effective MPA managers. Government commitment is key to achieve the necessary framework.

(5) Private sector engagement
The tourism industry was developed to motivate the government to protect natural capital from over-exploitation and prioritize sustainable development pathways.

(6) Sustainable financing strategy
The transition from an international NGO-driven and donor-funded initiative to one that is effectively managed entirely by local institutions and sustainably financed will be achieved through diversified revenue sources. A comprehensive cost model and business plan was developed to project revenues, costs and gaps.

3. Impacts
The BHS includes Indonesia's first effectively managed MPA network, its first legally established co-management system, and has the highest MPA management effectiveness scores in the country with an average score of 73%. MPA patrol teams were able to reduce destructive fishing practices to less than 1% of fishers in Raja Ampat MPAs. Illegal overfishing from outside poachers was reduced by over 90%. The government banned both mining and shark and ray fishing, and as a result, Raja Ampat has become a world-class tourism destination with an average annual tourism growth rate of 30%. Ecosystem health and local fisheries have started to recover. In Raja Ampat the average increase in live coral cover across MPAs has been ~12% since MPA establishment. The average increase in fish biomass across MPAs is ~114%. Local fishers are now catching more fish with the same level of effort. Evidence on the ground shows significant results, with communities catching more fish, revitalizing traditional practices, and finding new livelihood opportunities in the growing tourism sector.

Source: Source: IUCN, 2018 Publication, Solutions in Focus: Community Led Success in Marine Conservation

4.4 Support Community Development and Alternative Livelihood Projects

Fishermen, women, ethnic and indigenous groups and other community residents affected by fishing ban policies, by the marine conservation initiatives and by establishment of the wetland reserves, mangrove parks, etc., will be the major target groups and beneficiaries of the community development and alternative livelihood projects. They should be actively participating in the whole project cycle (see diagram 1 below). Major management steps and procedures of the community development and alternative livelihood projects include:

(1) Conduct Participatory Community Assessment & Baseline Survey. Major steps include: (i) by use of participatory rural appraisal (PRA) tools methods to conduct stakeholder mapping to identify who are affected by restriction of the resource use caused by MPA conservation; (ii) Carry out focus group interview and stakeholder consultation workshops for identifying the needs on alternative livelihood projects.

(2) Design and formulate the sustainable community development plan and livelihood development projects through participatory consultation and planning workshops with relevant affected fishermen and fisherwomen. Representatives of relevant governmental officials and community workers should be also invited to the consultation and workshops. NGOs and NPOs shall also be invited to the consultation and planning workshops.

(3) Review, approval and incorporation of the community development plans and proposed alternative livelihoods projects into the governmental investment projects with allocated financial budgets. The designed alternative livelihood projects shall be incorporated into the MPA conservation and management plan, and mainstreamed into the government supported marine community development programs. Budget should be provided by the government.

(4) Implementation and monitoring of the livelihood projects. (i) Skill and technology training shall be provided to the villagers who are identified as beneficiaries and target groups, 30-40% of female trainees must be attending the training events. (ii) Skill and Technology Transfer. Provide technical support during the implementation of the livelihood project activities; (iii) Monitoring the implementation process and ensure the quality of the project outputs.

(5) Adaptive Management and impact evaluation. Conduct semi-annual impact monitoring and evaluation and identify the deviations from the project design and make necessary modifications and adjustments based on the evaluation results.

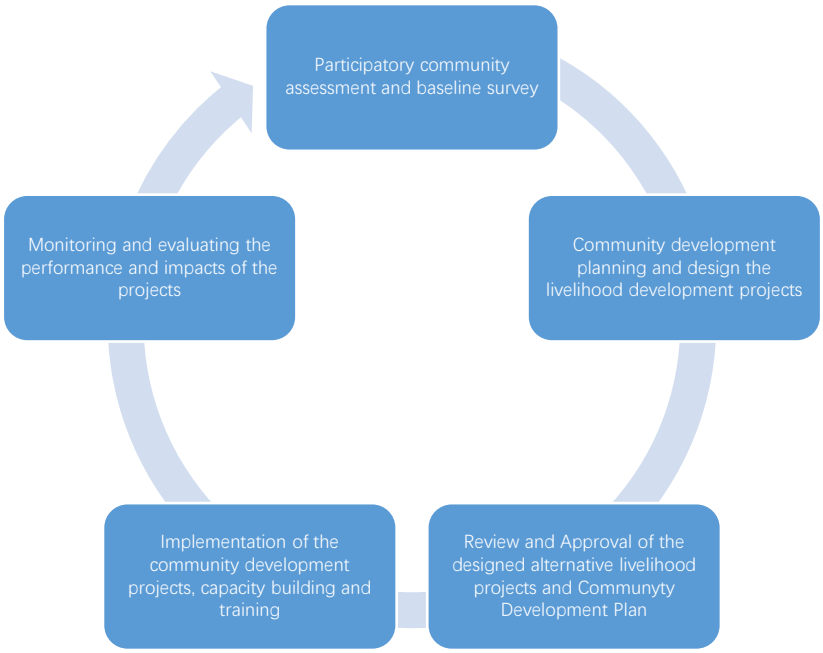


Diagram 1. The procedures of design and implementation of community alternative livelihood projects

During planning, implementation and evaluating the community development and alternative livelihood projects, to empower and facilitate the community stakeholders' active participation in the whole process, the project designing team will use tools and methods of Participatory Rural Appraisal (PRA).

Box 7. The PRA Tools applied in designing the community development projects

1. Introduction to PRA

Participatory Rural Appraisal (PRA) utilizes various visual, oral, and mapping tools, such as social maps, transect walks, resource maps, problem trees, and ranking exercises, to enable communities to analyze their own situations, identify needs, and plan development initiatives. The goal is to empower local people by emphasizing their knowledge and facilitating dialogue with outsiders, leading to solutions that are sustainable and meet community priorities.

2. Key PRA Tools and Techniques

PRA employs a menu of tools, which can be grouped by their primary function:

(1) Spatial and Mapping Tools

a) **Social Mapping:** Communities draw maps of their local area, identifying important features like houses, resources, and facilities, highlighting social relationships.

b) **Resource Mapping:** Similar to social mapping, but focuses on natural resources and how they are used.

c) **Transect Walk:** Facilitators and community members walk through the village, observing and discussing the environment and different land use patterns.

d) **Mobility Mapping:** Explores movement patterns of people, identifying where they go, why, and how often.

(2) Analytical Tools

a) Problem Tree/Solution Tree: Visualizes the causes and effects of a problem and then identifies potential solutions to address those causes.

b) Matrix Ranking: Used to compare and prioritize different options or solutions based on community criteria.

c) Venn Diagrams: Shows the relationships between different community groups, institutions, and external agencies, revealing power dynamics and connections.

d) Timeline: Documents key events, changes, and trends over time in the community, which can help identify historical patterns and issues.

(3) Participatory Tools

a) **Focus Group Discussions:** Facilitated discussions with specific groups or key informants to gather in-depth information on particular topics.

b) **Brainstorming:** A group activity to generate a wide range of ideas and potential solutions to a problem.

c) **Action Planning:** A collaborative process to create detailed plans for implementing identified solutions, including who will do what, when, and where.

3. Principles of PRA application

(1) Empowerment: PRA centers local knowledge and experience, shifting the stick of analysis to the community itself.

(2) Participation: It requires the active involvement and collaboration of community members in all stages of the appraisal.

(3) Flexibility: PRA facilitators are encouraged to be adaptable, listen, learn, and embrace mistakes as part of the learning process.

(4) Visual and Oral Communication: Tools often rely on pictures, symbols, and physical objects to avoid barriers for people with limited literacy.

Box 8. Integrated MPA Conservation and Community Development in Qi'Ao Island, Zhuhai City

1. Summary of the case

Qi'Ao Island is located in the Pearl River Estuarine Region, the east part of Zhuhai City. The traditional livelihoods of the Island Community is depending on sea fishery, aquaculture by use of mangrove wetland. In 1990s, due to the fast population growth, local residents overexploited the fish resources and expanded the aquaculture areas by transforming the mangrove forest area into fish pond farms. The mangrove forest area shrank from more than 316 ha in 1980s to 32 ha in the end of 1990s, declined about 90%. The biodiversity, both animals and botanic species, are also declined significantly.

To response to such challenges and degradation of wetlands, Zhuhai city government established Qi'Ao-Dangan Islands Natural Reserve Administration in later 1990s. The Nature Reserve Administration established partnership with the Qi'Ao Fishery Community. Community participation, integrated MPA conservation with community development have shown a win-win impacts.

2. Actions taken

(1) Initiating the Community Participation

Since 2016, the reserve has collaborated with non-governmental organizations

(NGOs), such as the Zhuhai Association for Geography and Nature Education, to launch a pilot program called Community Nature Education Classroom. The first cohort of 20 residents to become nature guides. In 2018, a Party Building Cooperation Agreement was signed with the Qi'ao Community, leading to the establishment of an ecological police station. The community patrol team actively participated in forest protection and monitoring efforts.

(2) Integrating Mangrove Reserve Conservation with Community Sustainable Development

While implementing the Mangrove Reserve Protection, returning the aquaculture area to the protected area, the Qi'Ao-Dangan Island Nature Reserve Administration and local government started to support community livelihood activities, such as eco and cultural tourism integrated with the constructed mangrove reserve with nature education functions, at the same time, family handicraft shops, homestay and restaurants, village museum, historical relics and culture heritages, etc., also become very important elements for attracting tourists and visitors from outside.

3. The Win-Win Results and Impacts

Through about ten years pilot, the integrated MPA and Community Development Model has shown a Win-Win Result. The Nature Reserve Administration and Volunteers supported the Qi'Ao Community in establishing Nature Education Schools, which attracted outside tourists and visitors, particularly children and youth. In 2024 the Mangrove Reserve (park) and the nature education schools have totally received a total of 12,000 visitors. Visitors are also consumers contributing to the local economy. This builds a virtuous circle of stimulating conservation and development. Community benefited from catering and hospitality, from retail of handicrafts shops and tea shops, from selling tree seedlings to the nature reserve, from employment generated from patrolling, tree planting, etc. A total of 80 job opportunities for local residents. As the increase of tourist numbers, the average annual income of local residents has also improved significantly, reaching CNY25,000/person, which has effectively enhanced their living standards.

In terms of ecological initiatives, the community has introduced innovative programs such as Mangrove Carbon Sink Adoption and Migratory Bird Naming Protection, public awareness of ecological conservation and encouraging environmental protection through tangible actions. These initiatives have received widespread support from across society. In 2023, through the sales and adoption activities of these ecological programs, 500,000 yuan was successfully raised. All funds will be allocated to support environmental protection projects within the community, further promoting sustainable development and enhancing the ecological environment.


Photo: by the Research Team

Table 7: Key Indigenous Marine Conservation Initiatives in Asia-Pacific Region

	Indigenous Group/Location	Core Approach	Key Outcomes
Torres Strait Ranger Program	TSRA, Australia	Cultural knowledge + scientific monitoring	Turtle/digong protection;14 communities engaged
QEN'T Marine Protected Area	Tsawout Nation, Canada	Smart buoy technology + IPCAs	Real-time ocean data; sovereignty assertion
Ningaloo Outlook	Baiyungu/Yinigu dera, Australia	Traditional tracking + satellite tagging	Whale shark migration maps; deep reef discoveries
Babel Mangrove Restoration	Bangka Belitung, Indonesia	Traditional planting + government collaboration	4,700 ha restored; community ecotourism developed

5.4. Incorporate Indigenous Knowledge into MPA Conservation

In APEC Region, there are a number of indigenous communities whose livelihoods are traditionally depending on the marine fishery and use of coastal territorial resources. These indigenous people developed and adopted indigenous fishery skills and knowledge to be harmonized with the marine ecosystems. Therefore, it is very important to consider their traditional livelihoods and incorporate their indigenous knowledge into MPA conservation strategies and program.

The governmental MPA management authority must recognize that incorporating indigenous knowledge is not a technical step but a transformative process of shifting power, respecting rights, and creating new, shared institutions for governance. The procedure must be flexible, community-led, and built on a foundation of genuine partnership and legal recognition. The most successful MPAs in APEC will be those co-governed by the Indigenous Peoples whose knowledge and futures are inextricably linked to the sea. Following are major issues and procedures for guiding the practical actions:

5.4.1 The Guiding Principles (Pre-Conditions)

Before any procedural steps, these principles must underpin the entire process:

- Free, Prior, and Informed Consent (FPIC): The right of Indigenous Peoples to give or withhold consent to any project affecting their territories and knowledge.
- Indigenous Data Sovereignty: IK and data generated belong to the Indigenous community. They control its collection, storage, access, and use.
- Two-Eyed Seeing (Etuaptmumk): A Mi'kmaq principle advocating viewing the world through the strengths of both Indigenous Knowledge and Western science

as co-equal, parallel systems.

- Recognition of Rights: Formal recognition of Indigenous land/sea tenure, governance structures, and cultural rights is the necessary foundation.

5.4.2 Procedures and steps

Phase 1: Foundation & Relationship Building (Pre-Project)

The objective of this phase is to establish trust, mutual understanding, and formal agreements. Following steps shall be conducted:

Step 1: Initial Self-Education & Identification

- Project Leads must educate themselves on the colonial history, rights, and political context of the Indigenous Peoples in the project area.
- Identify the legitimate custodians and knowledge holders (Elders, fishers, healers, community leaders), respecting that authority may not lie with state-appointed bodies.

Step 2: Initiate Contact & Protocol

- First contact should be made through existing Indigenous governance bodies (e.g., Tribal Council, Traditional Council, Prescribed Body Corporate).
- Adhere to local cultural protocols (e.g., gift-giving, ceremonies, formal meetings in the local language).

Step 3: Scoping Dialogue & Expression of Interest

- Hold initial dialogues to present the broad MPA project goals and listen to community priorities, concerns, and existing knowledge systems.
- Determine if there is a genuine community interest in collaboration. This process cannot be rushed.

Step 4: Negotiate a Formal Partnership Agreement

- Co-develop a Memorandum of Understanding (MOU) or Collaborative Management Agreement.
- Key Clauses Must Include: FPIC; governance structure (e.g., co-chair committee); intellectual property rights over IK; data sovereignty and management plan; benefit-sharing (funding, capacity, employment); conflict resolution mechanisms; and clear exit clauses.

Phase 2: Co-Design & Planning

The objective of this phase is to collaboratively design the MPA's objectives, boundaries, rules, and research/monitoring plan. Following steps shall be undertaken:

Step 1: Establish a Co-Governance Structure

- Form a Joint Management Committee or Working Group with equitable representation and consensus-based or co-chaired decision-making.
- Secure a dedicated budget for Indigenous partner participation (honoraria, travel, administrative support).

Step 2: Joint Knowledge Dialogue & Mapping

- Conduct participatory workshops using culturally appropriate methods (e.g., storytelling circles, seasonal calendars, boat-based transects with knowledge holders).
- Cultural Mapping: Use tools like GIS to map IK layers (e.g., sacred sites, traditional fishing grounds, spawning aggregation areas, historical villages, migratory routes, place names). IK holders control what is recorded and its accessibility.

Step 3: Integrate Knowledge Systems for MPA Design

- Boundary Setting: Use IK on ecosystem connectivity, species hotspots, and cultural significance to inform MPA zoning (no-take, seasonal closures, general

use).

- Regulation Development: Co-develop management rules based on IK practices (e.g., rahui, tabu, lunar cycle restrictions, species-specific bans).
- Objective Setting: Define success metrics that include both ecological (e.g., fish biomass) and socio-cultural indicators (e.g., use of language in naming species, youth participation in harvesting, spiritual health of the sea).

Phase 3: Implementation & Co-Management

The objective of this phase is to carry out management, monitoring, and enforcement activities guided by the co-designed plan.

Step 1: Co-Develop a Combined Monitoring Framework

- Design monitoring that values both IK and scientific data.
- Example: Combine underwater visual censuses (science) with Elder-led seasonal observations of species abundance and behavior (IK). Use Community-Based Monitoring programs employing local rangers or kaitiaki (guardians).

Step 2: Joint Capacity Building & Employment

- Create roles for Indigenous Guardians, Rangers, or Wardens to lead on-ground/on-water management.
- Facilitate two-way training: scientists train community members in monitoring techniques; knowledge holders train agency staff and scientists in local ecology, language, and protocols.

Step 3: Adaptive Management via Two-Eyed Review

- Hold regular joint review meetings to assess monitoring data and IK observations.
- Empower the co-governance body to adapt management rules based on this integrated understanding (e.g., extend a seasonal closure if IK and data both indicate slow recovery).

5.4.3 Key Tools & Enablers for Application in APEC Economies

- APEC-Ocean Related Meetings & Fora: Use these platforms to share successful models (like those from Canada; Fiji; New Zealand) and develop region-wide guidelines.
- Dedicated Funding Windows: APEC projects and development banks should create funding lines specifically for Indigenous-led conservation initiatives.
- Legal Support: Provide resources for communities to navigate legal frameworks for land/sea rights and IK intellectual property.
- Digital Platforms: Support the development of regional, Indigenous-controlled data repositories for IK related to ocean health.

5.4.4 Critical Pitfalls to Avoid

- Tick-box Consultation: Treating IK as anecdotal data to be collected rather than a living system of governance.
- Ignoring Power Imbalances: Not addressing the inherent power differential between state agencies and Indigenous communities.
- Focusing Only on Useful Knowledge: Valuing only IK about species or places that align with pre-set scientific goals, while ignoring spiritual, historical, or holistic aspects.
- Project-Based Thinking: Approaching this as a short-term project instead of a long-term nation-to-nation or community-to-agency relationship.

6 Development and Application of MPA Restoration Technologies

6.1 Research and Monitoring Priorities

Advance scientific understanding of marine ecosystems and the effectiveness of conservation measures through targeted research and long-term monitoring programs. Key priorities include:

(1) Establishing baseline assessments of biodiversity and ecosystem health to measure changes over time.
(2) Researching ecosystem structure and function to better understand species interactions and trophic relationships.
(3) Studying the impacts of human activities and developing strategies to mitigate negative effects.
(4) Investigating the socioeconomic dimensions of marine resource use to inform management decisions.

6.2 Technology Innovation and Application for Restoration

6.2.1 Marine Ecosystem Restoration Technologies

In the past two decades, a series of ecosystem restoration technologies have been developed and piloted with good results. The technology development mainly targets the key marine ecosystems such as coral reefs, seagrass beds, mangrove forests and salt marsh wetlands.

(1) Coral Reef Restoration: key technologies and solutions include: Pollution control and water quality improvement, reducing physical disturbance to the coral reefs; restoring the coral habitats, construct artificial coral reefs and substrate stabilization techniques; coral larval cultivation and coral nursery techniques; coral transplantation technologies and impact monitoring, etc.
(2) Seagrass bed restoration: Technologies and approaches to restore the seagrass beds include: restoration of the habitats through removing threats of human activities, restoring the hydrodynamic conditions; vegetation restoration through nature rehabilitation and replanting; control the water pollution and harmful organisms, such as large algae and sea urchins, etc.
(3) Technologies and approaches to restore the degraded mangrove forests. Based on identified degradation threats, following key technologies can be applied: mangrove habitat restoration, include the restoration of hydrodynamic conditions, the restoration of mudflat topography and geomorphology, and the transformation of sediment types; mangrove vegetation restoration, such as beach and forestry closure, replanting, etc.; control invasive species Spartina alterniflora and clean up vine plants.
(4) Coastal salt marshes restoration: pilot and apply technologies and approaches for: a) Restoration of loss habitat through engineering measures; vegetation restoration through enclosures, reducing the damage and replanting; control the invasive species, etc.

In 2022, Chinese Ministry of Natural Resources has released *Technical Guidelines for Marine Ecological Restoration* which includes procedures and key technologies for restoring the degraded marine ecosystem. This guideline can be shared among the APEC member economies though capacity building cooperation event.

6.2.2 Monitoring and Surveillance Technologies

Harness innovative technologies to improve marine conservation outcomes and support sustainable community development. Major Monitoring and Surveillance Technologies include:

(1) Remote sensing and satellite technology for monitoring illegal fishing and habitat changes
(2) Environmental DNA (eDNA) sampling for cost-effective biodiversity assessment, as demonstrated in Chinese Taipei's comprehensive survey of fish diversity in waters 0-3 nautical miles offshore
(3) Digital platforms for data sharing, citizen science, and transparent governance
(4) Fishing gear innovations that reduce bycatch and habitat damage

Table 8: Advanced MPA Biodiversity Monitoring and Surveillance Technologies in APEC MPAs

Technology	Key Applications	APEC Implementation Examples
Artificial Intelligence	Species identification, threat detection, population monitoring	Turtle monitoring on Great Barrier Reef, Chinese Taipei 's fish diversity surveys
Drones/UAVs	Aerial surveys, wildlife tracking, habitat mapping	Dugong and dolphin monitoring in Australia, coastal surveillance in Chinese Taipei
Environmental DNA	Biodiversity assessment, early warning of invasive species	Crown-of-thorns starfish detection, comprehensive fish surveys in Chinese Taipei
Robotic Systems	Coral restoration, deep-water surveys, automated sampling	Coral larvae tracking, underwater maintenance and monitoring

Box 9. Marine eDNA Technology

Environmental DNA is a set of techniques for identifying DNA found in the environment (e.g., water, soil, air) from cellular material shed by organisms that has accumulated in the surrounding water, soil, air, etc. It allows for testing without having to sample the organism itself. eDNA is developing into a powerful tool for improving the monitoring and detection of invasive species, which may be present in low numbers and therefore difficult to find. There are a wide range of ongoing efforts by federal and non-federal groups working to improve and apply eDNA to invasive species monitoring and management.

Marine eDNA technology involves collecting a water sample, filtering it to capture the DNA, and then analyzing the genetic material in the lab to identify which species are present without ever seeing or catching them.

The Basic Process of eDNA Techniques:

- Collection: A water sample is taken from a specific location and depth;
- Filtration: The water is filtered through a fine membrane to capture cellular material containing DNA;
- Extraction: DNA is isolated and purified from the filter in a laboratory;
- Analysis: This is the core of the technology, primarily using two methods:

Advantages of the eDNA technique:

- Highly Sensitive: Can detect rare, elusive, or cryptic species that are often missed by traditional methods, including species that live in difficult-to-sample environments (e.g., deep sea).
- Cost and Time Effective: A single water sample can contain information on hundreds of species, drastically reducing the time, labor, and cost required for ship-based surveys.
- Comprehensive Biodiversity Snapshots: Provides a biomonitoring net that captures a broad spectrum of life, from bacteria and plankton to fish and marine mammals, from a single sample.
- Access to Logistically Challenging Areas: Ideal for monitoring deep-sea vents, under ice, or complex structures like coral reefs.

Future Directions and Applications
eDNA is rapidly evolving and is set to become a cornerstone of marine conservation and management:

- Standardized Monitoring: Integration into national and international programs for long-term ecosystem health assessment (e.g., for Marine Protected Areas).
- Detection of Invasive Species: Early warning system for detecting non-native species before they become established.

- Conservation of Endangered Species: Monitoring the presence and range of rare species like the vaquita porpoise or certain sharks.
- Fisheries Management: Complementing stock assessments by detecting spawning grounds or the presence of commercially important fish larvae.
- Biome-Wide Assessments: Projects are already using eDNA to map biodiversity across entire ocean basins, providing an unprecedented view of marine life distribution.

7 Pilot Sustainable Economic Development Pathways

7.1 Blue Economy Initiatives

Develop sustainable blue economy initiatives based on AI and modern technologies, equipment and facilities which will provide economic opportunities and reduce the MPA biodiversity pressures caused by traditional marine fishing activities. The following actions are recommended to the APEC economies:

(1) Promote sustainable fisheries and aquaculture that minimize environmental impacts and maintain ecosystem structure and function in the river estuarine wetland areas. Intensive fishing farms equipped with modern facilities and use the sea water for intensive sea fish cultivation. This is an alternative production model adopted by the local communities with support from the government.
(2) Promote the development of marine ranching (sea farming) equipped with modern engineering technologies, and AI-supported facilities for high and intensive fishery production and lower ecological pressure on the ocean ecosystem. Through building the sea farms in the selected sea areas, the traditional marine fishing area can be reduced. Among the APEC economies, People's Republic of China; Japan; Republic of Korea; and USA have developed the sea farming models which can balance the fishery production.
(3) Support eco-friendly tourism that generates income for local communities while raising awareness about marine conservation.
(4) Develop marine biotechnology applications that derive value from marine genetic resources while ensuring equitable benefit-sharing.
(5) Invest in sustainable maritime transport and port infrastructure that reduces pollution and habitat destruction.

Box 10. Sea Farming Development in China

In 1990s, China has started the pilot of intensive sea farming models. Through more than thirty years development, until 2024, 189 economy-wide level large sea farms have been constructed in Shandong, Zhejiang, Jiangsu, Fujian and Guangdong Province. The total production value of sea fish products reached more than CNY100 billion, the total fish production reached more than 10 million tons. As part of the marine blue economy, through fast sea farming development, the overfishing caused by traditional marine fishing has been under control.

Sea farming model has following features:

(1) Converting the traditional marine fishing model to ecological and AI supported smart aquaculture model, for high value of intensive fishery and conserving the sea ecosystem at the same time;
(2) Combining the sea farming, marine wind energy generation and marine ecotourism together for generating extra value and profits;
(3) Driving by the modern technologies, facilities, equipment and AI supported smart fish cultivation, pollution control and marine environment monitoring which can reach three objectives of high production, high product quality and marine ecosystem conservation.



Photo source: www.image.baidu.com

7.2 Sustainable Financing Mechanisms and Fund Raising

7.2.1 Development of MPA Conservation Financing Mechanism

Establish diverse financing mechanisms fund-raising channels to support long-term marine conservation and sustainable community development programs and projects. These may include:

(1) Payment for Ecosystem Services (PES) schemes that compensate communities for conservation actions.
(2) Conservation trust funds that provide stable funding for protected area management.
(3) Green bonds and other innovative financial instruments that channel private capital toward sustainable marine initiatives.
(4) Economic incentives such as tax breaks or preferential licensing for sustainable businesses.
(5) Assist MPAs and Marine Nature Reserves to develop blue-carbon products through accounting carbon reduction and trading the national and global carbon market to raise funds for MPA conservation and sustainable community development projects.

Table 10: Sustainable Financing Mechanisms for Marine Conservation

Mechanism Type	Description	Applicability in APEC Region
Payment for Ecosystem Services	Direct payments or in-kind benefits to stewards of marine ecosystems	Particularly suitable for economies with strong community tenure systems
Conservation Trust Funds	Endowment funds that generate interest for conservation activities	Effective for long-term funding of MPAs and conservation programs
Blue Bonds	Debt instruments specifically for marine conservation projects	Growing interest across APEC economies, particularly for large-scale initiatives
Eco-Certification and Labeling	Price premiums for sustainably harvested marine products	Effective for fisheries with access to premium markets
Tourism Fees	Revenue generated from visitor fees to marine protected areas	Already implemented in many APEC economies with significant marine tourism

7.2.2 Proactive fund-raising through existing Foundations and Financing Facilities

MPA Mobilizing funds from regional and global foundations for MPA biodiversity conservation and climate resilient and sustainable livelihoods projects. Following national and global foundations and financing platforms can be considered by China

and APEC member economies:

Box 11. Fund Raising Platforms for MPA Conservation and Sustainable Community Development Programs

(1) **The Ocean Foundation**: As the only mainre conservation related community foundation based in Washington City, USA. This foundation aims to improve global ocean health, climate resilience, and the blue economy, addressing the funding gap for ocean science and conservation. https://oceanfdn.org/

(2) **China Oceanic Development Foundation (CODF)**: CODF is established in 2015 with mission to promote marine development in China and cooperation and dialogues with maritime silk road partner countries. This foundation works on various initiatives related to enhance marine sustainable development capacity of the developing partners, UN Marine Decade Conference, capacity building in Marine Spatial Planning and Coastal Belt Assessment in Maritime Silk Road Countrie. https://www.cfocean.org.cn/

(3) **Ocean Sustainability Foundation (OSF)**: OSF is based in Paris, France. The foundation devoted to protecting the ocean as a vital natural space and a Common Good of Humanity, the Ocean Sustainability Foundation was created to foster the creation of an International Platform dedicated to tackle Ocean Sustainability challenges. This organization gathers ocean scientists and experts to implement sustainable practices and promote ocean health. https://ocean-sustainability.earth/

(4) **One Ocean Foundation**: The foundation is established and based in Italy with the mission on advancing scientific understanding of the ocean, this foundation fosters sustainable solutions for protecting marine ecosystems. Concrete missions are to accelerate solutions to ocean issues by expanding scientific research, spreading ocean knowledge, and fostering opportunities for businesses and individuals to take an active role in the protection of the marine ecosystems. https://www.1ocean.org/

(5) Green Climate Fund (GCF): GCF is a global funding platform which can support climate resilient and ecosystem conservation initiatives as well as the community adaptation projects, https://www.greenclimate.fund/

(6) The Global Environmental Facility (GEF): GEF is a global funding platform for financing climate mitigation and adaptation programs and climate resilience capacity building actions. https://www.thegef.org/

8 Capacity Building and Knowledge Exchange

8.1 Technical Training and Education

Strengthening human capacity for marine conservation and sustainable development through comprehensive training and education programs. APEC economies should:

(1) Conduct training need assessment by relevant governmental line agencies and

technical and management staff of MPA Administrations and Marine Natural Reserves,
(2) Prepare training curricula and develop training materials;
(3) Support technical training courses, seminars and workshops;
(4) Develop professional certification programs for marine protected area managers and conservation practitioners;
(5) Create vocational training opportunities in sustainable marine-based livelihoods for community members;
(6) Integrate marine conservation topics into school curricula at all levels to build environmental awareness;
(7) Support higher education programs in marine affairs and conservation biology to develop future leaders.

8.2 Knowledge Sharing and Best Practices Replications

Facilitate exchange of experiences and lessons learned across APEC economies through platforms such as:
(1) Conduct Regional workshops and symposiums like the upcoming Marine Biodiversity Conservation and Sustainable Community Development Symposium.
(2) Support to establish professional networks and communities of practice that connect conservation practitioners across the APEC member economies.
(3) Establish digital platforms that document and share case studies and best practices.
(4) Staff exchange programs between APEC member economies that allow professionals to learn from different institutional approaches.

9 Implementation Framework and Monitoring Progress

9.1 Policy Integration and Coordination

Ensure effective implementation of these guidelines through strong policy integration and institutional coordination. APEC economies should:

(1) Mainstream marine biodiversity considerations into sectoral policies for fisheries, tourism, transportation, infrastructure construction, waste management and energy. Mainstream the MPA conservation performance into governmental development planning as well as the governmental performance evaluation system.
(2) Establish interagency task forces to coordinate implementation across different governmental departments, build the multi-stakeholder's coordination platform for MPA conservation and formulate policy guidelines and coordinate the actions by different line agencies.
(3) Develop sub-regional cooperation mechanisms to address transboundary marine conservation challenges.
(4) Align national policies with international commitments under various environmental agreements, such as member economies' commitment to SDG 11 (Sustainable Cities and Communities), SDG 14 (conserve life below water) and

SDG 15 (conserve life on land), CBD COP15 (Kunming), etc.

(5) The APEC Ocean and Fisheries Working Group (OFWG) provides an existing mechanism for coordination and collaboration on marine conservation initiatives across member economies.

9.2 Monitoring, Evaluation and Learning

Establish robust monitoring and evaluation frameworks to track progress and facilitate adaptive management. Key elements include:

(1) Defining clear indicators for measuring progress toward conservation and community development goals
(2) Creating baseline assessments against which future changes can be measured
(3) Implementing regular reporting systems that document achievements and challenges
(4) Conducting periodic independent reviews to assess effectiveness and identify areas for improvement

The APEC Services Cooperation Framework provides a mechanism for tracking implementation efforts and sharing progress across economies.

Table 11: Suggested Framework for Monitoring and Evaluating the Performance and Impacts

Category	Key Indicators	Measurement Approaches
Ecological Status	Species diversity, population trends of key species, habitat extent and condition	Scientific surveys, remote sensing, citizen science
Management Effectiveness	Enforcement coverage, budget adequacy, staff capacity	Institutional assessments, expert evaluations
Community Well-being	Livelihood diversity, income levels, food security	Household surveys, economic data analysis
Governance Quality	Stakeholder participation, women's representation, policy coherence	Stakeholder interviews, document review
Economic Sustainability	Revenue from sustainable activities, conservation financing	Economic analysis, financial records

10 Policy and Action Recommendations

The policy and action recommendations presented below are formulated based on a comprehensive synthesis of the project's extensive policy research, the findings from the stakeholder questionnaire survey, and the expert consensus reached during the APEC Workshop.

Significantly, on the afternoon of October 29th, a dedicated half-day closed-door

session was organized during the APEC Workshop in Shenzhen. This session provided a confidential platform for representatives to frankly discuss specific challenges and share regional perspectives. The detailed views and feedback from various APEC economies recorded during this session are documented in the separate Workshop Summary Report. The recommendations in this section have fully incorporated these diverse economic perspectives and expert insights, ensuring they reflect a broad regional consensus rather than a single viewpoint.

Our combined analysis—spanning policy research, survey data, and the afternoon closed-door consultations—highlighted that the successful implementation of these guidelines requires strong governmental political commitment, adequate resource allocation, and the encouragement of active engagement from all stakeholders—particularly community stakeholders and marine/wetland resource users. By working together across economies and sectors, APEC can demonstrate global leadership in integrating marine conservation with sustainable development, creating a model for other regions to follow.

10.1 Attach high importance to MPA conservation

Basis for Recommendation:
Policy analysis indicates that while many economies have MPA frameworks, gaps remain in implementation and inclusivity. The survey results supported this diagnosis, identifying the lack of legal recognition of community rights (47% of respondents) as a barrier, while improving government policy was a top requested support mechanism.
Therefore, it is recommended to local governments:

(1) Policy Priority in Planning: Attach high policy importance to urban MPA conservation by mainstreaming it into the governmental Five-Year Development Planning systems. Specific conservation target indicators (e.g., minimum protected areas, numbers of protected bird and botanic species) must be set up to guide project formulation and budgeting.
(2) Infrastructure Integration: MPA conservation projects must be mainstreamed into municipal development and investment plans to ensure that essential protection infrastructures and biodiversity monitoring facilities are constructed.
(3) Ecological Redlines: Set up ecological redlines to legally prohibit negative impacts of economic activities on MPA biodiversity.
(4) Ecological Valuation: Conduct MPA ecological valuation assessments to estimate the economic value of MPAs. Use these values as a reference for setting up financial compensation criteria for resource users who must displace their economic activities for conservation purposes.

10.2 Improve MPA Policy and Governance System

Basis for Recommendation:
Policy analysis indicates that while many economies have MPA frameworks, gaps remain in implementation and inclusivity. The survey results supported this diagnosis,

identifying the lack of legal recognition of community rights (47% of respondents) as a barrier, while improving government policy was a top requested support mechanism.

10.2.1 Policy improvement and formulation

(1) Review and Assessment: Conduct periodic policy reviews and assessments of implementation results to identify gaps and weaknesses in the current policy system.
(2) Inclusive Consultation: Improve existing MPA-related policies through consultation with relevant governmental line agencies and stakeholders, particularly marine resource users, representatives of women, and Indigenous people.
(3) Context-Specific Legislation: Formulate regulations and laws for MPA conservation based on the specific local context of the member economies.
(4) Monitoring and Evaluation: Conduct policy and law implementation monitoring and supervision, evaluate impacts, and improve the institutional framework based on these results.

10.2.2 Improvement of MPA Governance and Policy Reinforcement

(1) **Inclusive Co-Governance of MPA**
   a) Implement multi-stakeholder and participatory governance models that formally incorporate indigenous knowledge, community perspectives, and scientific expertise into MPA management decisions.
   b) b) APEC economies should develop standardized guidelines for community engagement in MPA planning and management.

(2) **Policy Harmonization**
   a) Work toward greater regulatory alignment across APEC economies on MPA standards, monitoring protocols, and enforcement procedures while respecting diverse cultural and ecological contexts. This includes developing APEC-wide guidelines for MPA establishment and management effectiveness evaluation.
   b) b) Establish a policy exchange/consultation platform under the coordination of the APEC Ocean and Fisheries Working Group (OFWG) to develop harmonization mechanisms among member countries.
   c) c) Within individual APEC economies, establish multi-agency coordination mechanisms to harmonize conflicting policies related to resource management and conservation.

10.3 MPA conservation planning and mainstreaming into development strategy

Workshop discussions emphasized the need to shift from a protection vs. development mindset to a Blue Economy approach. Policy research confirms that integrating MPAs into broader economic strategies is essential for long-term viability.

(1) Strategic Documentation: Formulate domestic MPAs, Mangrove Wetland Restoration Guidelines, and Planning Documents to guide restoration and conservation activities.

(2) Integration into Economy-wide Plans: Incorporate and mainstream the MPA conservation strategy into central and local governmental Five-Year Development Plans and sectoral planning documents.
(3) Mainstreaming MPAs into National Blue Economy Strategies:
    a) Integrate MPA networks comprehensively into blue economy development plans, positioning protected areas as foundations for sustainable fisheries, tourism, and other marine industries rather than as constraints on economic activity.
    b) APEC economies should incorporate MPA Conservation and Blue Economy into their national and sectoral development plans, supporting the private sector to transform traditional marine fishing models into sustainable fishery and blue economy models.
    c) To guide Blue Economy Development, a national strategic plan shall be prepared by the responsible governmental department. (Note: China has already incorporated the Blue Economy Strategy into its 14th Five-Year Plan of Marine Economic Development).

10.4 Establish a multi-stakeholder's consultation mechanism

Basis for Recommendation:

International best practices reviewed in our research and the survey findings both indicate that involving community stakeholders—particularly resource users—in the entire process is a precondition for sustainable MPA management:

(1) Consultation Guidelines: Central and local governments should formulate guidelines for carrying out multi-stakeholder consultations and public hearings when formulating MPA policies and programs.
(2) Inclusive Participation: During project planning, community fishermen, indigenous groups, female residents, and other affected stakeholders should be invited to public hearings. To ensure effective participation, a consultation facilitator is needed, and participatory tools (e.g., visualization tools, resource transect walks, mapping) should be applied.
(3) Engagement in Implementation: Ensure stakeholder engagement in the project implementation and impact monitoring phases.
(4) Pilot Community Models: To enhance ownership, it is recommended to pilot community-based and community-led MPA conservation models, where communities have increased power and authority under the facilitation of government officials, NGOs, and NPOs.
(5) Institutionalization: To ensure sustainability, facilitate marine communities in establishing MPA Conservation Councils/Associations, governed by a formulated charter.

10.5 Ensure the financial investment to conserve the MPA

Basis for Recommendation:

Case studies presented at the workshop highlighted successful financing models, while the survey identified lack of funds for alternative livelihoods (53%) as the most critical challenge. Our policy analysis suggests a need to diversify beyond government grants:

(1) Establish and operate the Green Development Fund (GDF) or Marine Reserve Conservation Funds. Following fund raising channels can be considered: (i) governmental initial fund; (ii) International donors, such as ADB, World Bank, GEF, European Investment Bank (EIB), bilateral donors of OECD countries; (iii) social donation from civil society and enterprises.
(2) Pilot Wetland Bank Mechanism: Wetland Banking Mechanism (WBM) was initially developed in USA as a financial instrument for off-set the area loss of wetland through wetland mitigation banking. The model is also introduced into China for off-setting the losses of fresh water wetlands in Jiangxi Province and Forest Nature Reserve in Fujian Province. It is recommended to APEC economies to pilot financial model in MPA biodiversity conservation based on the local contexts.
(3) To pilot marine wetland blue carbon trade schemes. Assist marine communities to transform the traditional marine resource use partner into sustainable, low carbon emission and ecosystem/ biodiversity friendly resource use partners. The reduced carbon emission quotas generated through MPA conservation programs can be translated into the blue carbon products and traded in the carbon market. China and part of APEC economies have already established the carbon trade schemes, which can provide a carbon trade platform for the MPAs and communities.

10.6 Develop and replication of MPA biodiversity restoration technologies

Basis for Recommendation:

Workshop technical sessions demonstrated the power of new technologies. The survey reinforced this by highlighting a significant technical training need (65%) and a digital divide in monitoring capabilities.

(1) AI-Supported Monitoring: Develop AI-supported MPA biodiversity monitoring and resource surveillance technologies. Establish an MPA biodiversity network and databank shared by administrations for joint actions and policy formulation.
(2) Smart Fisheries: Apply AI-Driven Smart Fishery Management and AI-Driven Smart Aquaculture Management Systems.
(3) Restoration Technologies: Develop specific technologies for restoring seagrass beds, degraded coral reefs, and regulating wetland hydro-levels to sustain habitat ecosystems for migratory birds.

10.7 Supporting marine community alternative livelihood activities

Basis for Recommendation:

Policy research confirms that conservation fails if local communities lose income. The survey results show a strong correlation between lack of alternative livelihoods and illegal resource extraction.

(1) Conduct Participatory Community Assessment & Baseline Survey. Major steps include: (i) by use of participatory rural appraisal tools and methods to conduct stakeholder mapping and Consultation for identifying the needs on alternative livelihood projects; (ii) Conduct baseline survey to assess Ecological-Economic

Baseline with focus on- Deploy cost-effective tech (e.g., drone swarms for mangrove/coral mapping) to quantify resource health and livelihood impacts, and establish Redline Index metrics: habitat quality, violation resolution rates, and income diversification levels.

(2) Design the livelihood development projects through participatory consultation and planning workshops with relevant affected fishermen and fisherwomen. Representatives of relevant governmental officials and community workers should be also invited to the consultation and workshops. NGOs and NPOs shall also be invited to the consultation and planning workshops. The designed alternative livelihood projects shall be incorporated into the MPA conservation and management plan, and mainstreamed into the government supported marine community development programs. Budget should be provided by the government.

(3) Implementation and monitoring of the livelihood projects. (i) Skill and technology training shall be provided to the villagers who are identified as beneficiaries and target groups, 30-40% of female trainees must be attending the training events. (ii) Skill and Technology Transfer. Provide technical support during the implementation of the livelihood project activities; (iii) Monitoring the implementation process and ensure the quality of the project outputs.

(4) Adaptive Management and impact evaluation. Conduct semi-annual impact monitoring and evaluation and identify the deviations from the project design and make necessary modifications and adjustments based on the evaluation results.

10.8 Multi-Stakeholder Engaged Public Education Platform

Basis for Recommendation:

Workshop evaluations indicated a need for broader awareness, and the survey noted that 41% of respondents feel there is a lack of marine protection awareness in communities.

(1) Build a multi-stakeholder engaged public education partnership and platform. The platform will consists of local governmental MPA management authorities, nature reserves, professionals of universities and marine conservation related research institutions, nature education and protection associations and volunteers and university students, local community schools, fishery community representatives and social and public media; It is very important that the MPA and nature reverses set up partnerships with community schools in the surrounding areas for conducting the systematic nature education activities.

(2) Develop public education plan with specified objectives, trainers, target groups, topics and contents, education events, campaigns, budget and engaged actors and stakeholders.

(3) Development of education curriculums, materials, design MPA conservation posters, textbooks for school nature education, design community education leaflets and brochures, small souvenirs, etc.

(4) Support to conduct the public education activities, community campaigns and evaluate the performance and impacts.

10.9 Regional Cooperation and Partnership

Basis for Recommendation:

A key conclusion of the APEC project and workshop is that marine ecosystems are

interconnected. Policy research emphasizes that isolated management is less effective than regional networks.

(1) Transboundary MPA Conservation. Promote establishment of formal collaborative arrangements for managing MPAs across national boundaries, following best practices from existing transboundary marine conservation initiatives worldwide. APEC should develop a specific framework agreement to facilitate such arrangements between member economies.(see table 11 below)

(2) Public-Private Partnerships. Engage business communities through APEC's Business Advisory Council (ABAC) to develop market-based conservation incentives, corporate stewardship programs, and technology transfer initiatives supporting MPA objectives 3. The private sector represents an underutilized resource for MPA funding, innovation, and implementation capacity.

(3) Science-Policy Interface. Strengthen mechanisms for scientific input into MPA policy across APEC through regular scientific assessments, collaborative research programs, and formal science advisory processes. This should include traditional ecological knowledge alongside Western scientific approaches.

Table 12: Potential APEC Cross-Border MPA Initiatives

Initiative Type	Objectives	Participating Economies	Key Benefits
Migratory Species Corridors	Protect transboundary movement pathways	Economies along migration routes	Comprehensive protection for migratory species
Climate Resilience Networks	Protect diverse thermal refugia, genetic diversity	Economies with contrasting climate impacts	Enhanced adaptive capacity across region
Seamount Protection	Protect deep-sea biodiversity hotspots	Economies with offshore waters	Conservation of vulnerable marine ecosystems
Coral Triangle Expansion	Expand coral reef protection	Southeast Asian economies, Pacific Islands	Protection of global coral biodiversity center

10.10 Recommendations to APEC OFWG

(1) Sharpen Strategic Focus: Leveraging the Umbrella Effect. Future initiatives should move beyond general broad-based community participation and become more scientifically focused. We recommend that APEC economies strengthen protection for specific single species, known as Umbrella Species. Scientifically, the rigorous protection of these key species creates an umbrella effect—by protecting the large habitats required by these species, many other species in the same ecosystem are indirectly protected. Adopting this focused approach can significantly elevate the overall biodiversity conservation standards of an entire economy or region.

(2) Initiate a Transboundary Migratory Species Conservation Network. APEC is inherently a multilateral cooperation mechanism, making it the ideal platform to address challenges that no single economy can solve alone. We recommend

focusing on long-distance migratory species (such as sea turtles or dolphins) that traverse the jurisdictions of multiple APEC coastal economies.

- Actionable Proposal: When conditions are mature, the OFWG should initiate a specialized APEC Transboundary Migratory Species Conservation Network.
- Impact: This initiative would involve coordinated monitoring, data sharing, and joint enforcement across multiple economies, serving as a concrete and tangible measure to enhance the region's overall conservation level.

(3) APEC Marine Conservation task force: Establish a dedicated technical task force within APEC's institutional structure to coordinate MPA initiatives, share best practices, and develop common standards across member economies. This group should include representation from government agencies, scientific institutions, indigenous organizations, and civil society.

(4) Create a Digital Knowledge Platform: Create an APEC MPA Information Portal to facilitate information exchange, technology transfer, and progress tracking toward regional conservation targets. This platform should include standardized data on MPA locations, regulations, management effectiveness, and ecological monitoring results.

(5) Institutionalizing the Technical Exchange and Policy Dialogue through APEC financial support. The workshop participants suggested to institutionalize the technical and policy dialogues among the APEC economies, to normalize such kind of seminars and workshops. In addition to the annual APEC-OFWG conference, a quarterly online policy dialogue mechanism and an online community for frontline managers and researchers shall be established to ensure the continuity and breadth of collaborative communication.